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Lectures on the Electromagnet.

WE publish this week the concluding portion of Prof. S. P. Thompson's lectures on the electromagnet. They have more than fulfilled the expectations that were raised when it was first announced that the Cantor lectures for the current year would be delivered by that well known electrician on such an interesting topic. Besides being a resumé of all that has been done on the theory and practice of electromagnet construction, the Cantor lectures for 1890 are full of new and important matter bearing directly on some of the most practical problems with which the electrician has to deal. The treatment of the subject is very satisfactory, and the author certainly has left the electromagnet placed on a scientific basis, that, until now, had been hardly approached. The lectures will shortly be published by us in book form, as they are too valuable for ready reference to remain scattered through the files of THE ELECTRICAL WORLD. They are intensely practical and deal with questions that must be faced daily by the constructing electrician. They form as satisfactory a treatment of that side of the subject as that Professor Ewing has given to the theory of magnetism in iron and other metals, soon also to be before the public in complete form; higher praise than this in discussing any work relating to magnetism it is not in our power to give.

Electric Discharge Through Gases.

THE brief paper by Professor Trowbridge published in another column is worth more than a casual glance, for it deals with a most occult portion of electrical science, and is full of suggestiveness. It has been often tacitly assumed that an electric discharge in a gas is simply due to convection of electricity by the flying particles; but more careful study of this particular problem has led to the general conclusion that the passage of electricity through gases is a phenomenon of vastly more complex character than at first appears, and the present paper is devoted to a clever bit of experimental evidence against the convection hypothesis to which we have referred. The method of experiment adopted was both ingenious and effective, and the conclusion that there is no movement of the atoms corresponding at all in rapidity with the oscillations in the electric discharge seems to be thoroughly justified. Just what sort of complex combination of electrical strains is present in a gas through which electrical discharge takes place would be no easy matter to discover. The phenomena are exceedingly complicated and almost defy theoretical investigation, so that every bit of experimental evidence which can be obtained is doubly valuable. The fascinating part of a research of this sort is that one can never tell what unlooked for results may follow the performance of a comparatively simple experiment. An investigation often opens up a magnificent vista in a direction quite different from that in which the investigator was at first looking, and in no department of physical science is this more strikingly true than in modern electricity.

Electrical Construction.

WE publish elsewhere in our columns a few remarks from a constructing electrical engineer on the subject of some faults in our present practices that will repay careful reading. The writer evidently speaks from the heart, as one who has suffered from the tendency to cheapness that characterized much of the earlier construction work in this country, and that is by no means abandoned even now. There is a deal of truth in some foreign criticisms of American electrical work. Effective as it undoubtedly is, the element of durability is too often overlooked in the desire for cheap and rapid construction. We have, to be sure, many fine electric lighting and power stations, admirably equipped in every respect, and with line work which is a model of neatness and durability. Nevertheless there are many small stations scattered all over the country where our correspondent's criticisms will apply most forcibly.

Dynamos, engines and boilers are huddled together in dark, dirty quarters; the lines are strung loosely on rickety poles and over housetops; the insulation hanging from the wires here and there, and joints uniformly made by twisting the wires together without even a pretence at soldering them. We have even heard of one station where the dynamos are located in a shed and covered with a canopy of tarpaulin to keep off the rain. Almost every constructing engineer can tell a dismal tale of this sort from his own experience, and although it is but fair to say that the average practice is improving with great rapidity there is still much to be desired. As in most other cases, cheapness and badness go hand in hand in electrical construction, and even in cases where the machinery installed is of the best quality, it may be rendered hopelessly ineffective by skimping the remainder of the work. Mr. Woods' criticisms could be duplicated by many another engineer, and they should furnish food for thought to any of our readers who are interested in establishing electrical enterprises.

The Improved Tachypomp.

AN elaborate article was recently produced before a Western engineering society describing a somewhat revolutionary system of electrical or other traction. We presume that it will in due time turn up in the columns of some technical journals, but especially desire to prepare the minds of our readers for the sudden attack on their nerves that may be made through the medium of the daily press. The peculiarity of the system in question consists in the novel, not to say romantic, arrangement for securing varying speed. The device consists of an endless platform continuous throughout the entire route to be traversed, and running at a low rate of speed just above the level of the street. The wayfaring pedestrian when tired of walking may simply step upon this platform, which, from its low speed, he is very readily able to do, and will then be carried merrily along toward his destination. If, however, he is in a hurry it is only necessary for him to step from platform No. 1 to platform No. 2 to travel at twice the speed, and then on to Nos. 3, 4, 5.... n; each traveling at a greater speed than the former. Of course, as the speed of each platform relative to the preceding one is not high, it will be quite easy to step from one to the other. Another trifling peculiarity of this invention is that only the first platform runs upon the track, the others being furnished with rails to roll over wheels driven by the motion of platform No. 1. To the inventive mind, of course, many beautiful modifications of this principle will suggest themselves, all having the same common features of the continuous platforms and rates of speed varying from one to another. Far be it from us even to insinuate that the invention is old, but it is not inappropriate to call attention to a beautiful pre-existing modification of this plan due to the mental acumen of Mr. E. P. Mitchell, and published some years since in a brief monograph entitled "The Tachypomp." Mr. Mitchell's conception included a series of continuous moving platforms arranged in a way quite analogous to that which has just been described, except that each travels on its own wheels over a track laid on the next below, and the object of the invention is rather high speed than convenient access from the street. If the first platform be operated at a rate of 15 miles an hour, a speed quite within the reach of present electric railway practice, the second, third and fourth being operated at the same rate relative to their respective tracks, we shall have the fourth moving relatively to surrounding objects at no less than a mile a minute. Of course a multiplication of the platforms to the number of six, such as is suggested by the engineers of the new system to which we have been alluding, would give a speed of 90 miles an hour. The initial speed mentioned is, of course, needlessly low, and if it were desirable to introduce the tachypomp into general railway practice the first platform might be started at 40 miles per hour, which would give 240 miles per hour for the sixth platform, or, in general, 40 n miles per hour for the nth platform. The possibilities of this beautiful plan for electric traction present themselves at once, even to the eye of the novice, and quite throw into the shade all the propositions of electrical balloonists and pneumatic cranks. Of course the inventors of the Wild West system first mentioned have secured full patent rights for their modified tachypomp, and propose to use it around the grounds of the Columbus Exhibition in 1893. To this purpose it is better suited than to some others we could mention, but we trust that our suggestion of the possibilities inherent in Mr. Mitchell's very original tachypomp will not be wasted on the inventive genius that has already been so amply displayed. A continuously moving sidewalk might be a convenience, but the glorious possibilities of a speed of xn miles per hour ought to awaken world-wide enthusiasm.

Subway Machinations.

IT is high time that the public awakened to a due appreciation of the way in which its interests are being sacrificed for the benefit of certain private persons. The operations of the Subway Company are just now being brought prominently into notice by the attempt to divide the work for the benefit of a certain corporation and its backers. The proposition to turn over the work of low tension subway construction to a new organization formed of those largely interested in telegraph and telephone interests, met with a sudden rebuff during the past week in the form of an injunction that will delay the consummation of this amiable scheme for some little time. Just why the telegraph and telephone companies should be permitted to build their own subways while this privilege is denied to the illuminating companies is rather hard to determine. The new schedule of prices for subway accommodations promulgated by His Honor, the Mayor, will really give very little substantial relief. The regular price for yearly rental of ducts has been from $1,000 per mile for three-inch ducts to $750 for two-inch ducts. The proposition now is to reduce this to $900 for three-inch, $800 for two and a half-inch, and $700 for two-inch. But considering the fact that at least one reputable company will undertake to put down a proper system of conduits and rent them at a small fraction of the amount mentioned, the reduction made is simply farcical. Look for a moment at the facts in relation to subway accommodations for arc lighting. A single company in this city operates about 200 miles of conductors in conduits. Fortunately, the ducts are able to accommodate more than one cable, otherwise electric lighting would be quite out of the question at the present rentals. As a matter of fact, throughout the system just mentioned the average number of cables per duct throughout the territory covered in both arc and incandescent services is about two and a half, and on investigating the number of lights per mile which are served, it appears that the rental of conduits amounts to from $30 to $50 per arc light per year. In addition to this the maintenance of the underground lines entails heavy additional expenditure. Bearing in mind this fact the justice of the increase in price for city lighting asked by the illuminating companies in their recent bids becomes apparent. With an actual cost of subway rentals amounting for city lighting to not less than 10 cents per light per night, it certainly is not to be expected that the companies would continue furnishing city lights at the old prices established before this additional expense was forced upon them. As a matter of fact the amount asked would not cover the actual subway charges, leaving quite out of the question the increased cost of maintenance; nor would the companies be much better off if His Honor the Mayor's new schedule of rents were adopted. Just what object certain city authorities have in hampering the electric lighting service and placing it at the mercy of a company whose inefficiency and extortionate practices have already been demonstrated, it is hard to show conclusively. It is safe to say, however, that it arises from no patriotic or philanthropic motives. It may be from motives of economy that the Mayor favors going back to gas lighting, but economy has not been in other respects so prominent a characteristic of his régime as to lend much color to this supposition. Certain it is that the electric lighting companies are not prepared to back down, for the total number of arc lights operated for city lighting is not sufficient to make any perceptible decrease in the prosperity of those who have furnished them up to the present, even if they should all be replaced with gas. The effect of abandoning electric street lighting would not then be to damage the objects of His Honor's wrath, but rather to bring his administration into repute more evil, if possible, than that which already characterizes it.

Latest Foreign Electrical News.

(By Cable from our Regular Correspondent.)

LONDON, Dec. 15, 1890.—William Crookes, Esq., F. R. S., has been elected president of the Institution of Electrical Engineers.

It is finally officially announced that the City and South London Railway will be open to the public on Dec. 18. The results thus far have been so good that the Austrian Ministers of Commerce have decided to send two engineers to London to study the system adopted by this company with a view to using a similar method on the projected metropolitan railway in Vienna.

The Grosvenor Gallery station will not commence running until New Year's, as it is desired to take time for proper reconstruction, so as to avoid further breakdowns caused by hasty work.

A new development in electric traction is promised by the appearance of a new secondary cell for high discharge rates, just brought out by the Electric Construction Corporation of London. This new accumulator will stand a rate of discharge 30 per cent. higher than the usual forms.

At the meeting of the Physical Society on the 12th inst. Mr. Shelford Bidwell read an interesting paper on selenium cells. At the same meeting Mr. Swinburne's paper on alternating current condensers caused a very valuable discussion concerning the electrostatic phenomena on the Ferranti mains, in which Sir William Thomson took a prominent part.

NEW BOOKS.

HANDY LISTS OF TECHNICAL LITERATURE, Part II., A. By H. E. Haferkorn. Pp. 44. Milwaukee, Wis.: H. E. Haferkorn, 1890. 75 cents.

This little pamphlet is a reference catalogue of books printed in English from 1880 up to date, including also a limited number of books printed before that date. This period, as will be seen, covers, so to speak, the productive period of applied electricity. The list will be found to be tolerably complete; the main entry of each work is found under the author's name, giving full title, year of issue, publisher, editions and price. In addition the various books are elaborately cross-referenced by subjects for the convenience of dealers, and the various agents through whom the books may be obtained are listed by a system of abbreviations. If one were to offer a criticism on the book it would be that this system of abbreviations is inconveniently elaborate, requiring the use of a key, which is furnished in a small separate pamphlet. The list should have been made to include books in other languages than English to be of general service, and the omission of books on medical electricity seems unnecessary. It will be found, however, to contain a fair proportion of electrical books, and will frequently prove convenient for reference.

It is to be regretted that there is not in the English language a similar publication covering in a comprehensive manner the subject matter which appears from week to week in the principal electrical periodicals of this country and Europe. Such a list of current technical literature would involve, in its preparation, a vast amount of work, but would prove a valuable assistant to the student when searching through the files of periodical literature for the results of former investigations or for the illustration and description of some piece of electrical apparatus, the history of which he wishes to hunt up.

Providence Convention of the National Electric Light Association.

Those who propose to attend the coming meeting of the National Electric Light Association in Providence, R. I., Feb. 17 to 19, 1891, will be pleased to learn that the facilities furnished for exhibitors will leave little to be desired. It is the policy of the association to bring together as complete an exhibition of electrical apparatus and appliances as can be readily assembled, and to this end all the associate members, comprising the best known constructing electricians in the country, are earnestly requested to give their aid. A suitable hall has been secured opposite the hotel which will be the association headquarters, and through the courtesy of the Narragansett Electric Lighting Company there will be run in the hall three circuits: (1) an incandescent alternating current converted to 50 volts; (2) a 500-volt direct current from Thomson-Houston generators; (3) an arc current of 6.8 ampères.

There will be no charge for space or current to exhibitors, who must, however, be associate members of the association. The installation and care of exhibits, will, of course, be at the expense of the exhibitors. The exhibition hall will be open day and evening from Tuesday, Feb. 17, to Thursday, Feb. 19, and will be ready for the reception of installations as early as the Saturday previous.

Intending exhibitors may secure all necessary information by reference to Gen. C. H. Barney, Chairman of the Committee on Exhibits, 20 Cortlandt street, New York. As the space is limited and will be allotted in the order in which applications are received it behooves exhibitors to secure space as early as possible.

Electrical World Portraits.—XIX.

PROF. W. E. AYRTON, F. R. S.

The name of Professor Ayrton is a familiar one in every corner of the world where electrical apparatus is used today, for by his long connection with the development of practical electricity and his valuable additions to the theoretical part of the science, he is singularly well known to practical men.

Prof. W. E. Ayrton is one of the elder group of electricians who began his services to electrical science in the telegraph. He was educated at University College school, and after a brilliant record as a scholar there, entered University College, London, where he received his degree of B. A. in 1867. Shortly afterward he determined to enter the Indian government telegraph service, and came out at the head of the list in the examination required. He was then sent by the Secretary of State for India to study electrical engineering with Sir William Thomson, and shortly afterward entered the Indian telegraph service as assistant electrical superintendent. During his Indian residence he introduced many improvements into the management of the government telegraphs, especially with reference to telegraph testing, a subject of great importance in the Indian climate. He was soon promoted to be the electrical

PROF. W. E. AYRTON.

superintendent of the telegraph department, and after about five years of service was put on special duty in England in behalf of the department, and in charge of the Great Western Telegraph Manufactory, in London, for the engineers, Sir William Thomson and the late Prof. Fleeming Jenkin. It was at this period that he finally turned from the telegraph service to an educational career, and in 1873 was appointed Professor of Natural Philosophy and of Telegraphy at the Imperial College of Engineering, Japan, which was and is one of the largest technical institutions in the world. During his residence in Japan, Prof. Ayrton began the long series of researches on practical electricity which have resulted in so valuable an addition to electrical literature. The scientific papers, published for the most part in the Philosophical Transactions of the Royal Society, attracted widespread attention, and in 1879 he was called back to England, to assume the position of Professor of Applied Physics at the City and Guilds' London Technical College, Finsbury, where his work rapidly brought him into prominence. In 1880 he was a secretary of the Mathematical and Physical section of the British Association, and in 1881 was elected a Fellow of the Royal Society. In 1884 he became the chief Professor of Physics at the Central Institution, South Kensington, a position which he still holds. He is president of the Physical Society, a vice-president of the Institution of Electrical Engineers, and has served in some official capacity at most of the electrical exhibitions in England and elsewhere. In addition to his scientific contributions to periodical literature, he is joint editor of the Manuals of Technology, published by Cassell & Co., and is the author of "Practical Electricity," one of the volumes of that series which has already passed into its third edition, and has made a very decided success a being one of the most thoroughly practical and useful text-books on the subject.

Prof. Ayrton is also well known as a popular lecturer, and his lecture on "The Electric Transmission of Power" at the Bath meeting of the British Association in 1888 was so well appreciated that, at the request of the town, it was repeated to an immense audience; the first time in the history of the British Association that a repetition of one of their popular lectures has been demanded.

Together with Prof. John Perry, who was his colleague in Japan, he is the joint inventor of an admirable series of electrical measuring instruments, of which the spring voltmeter and ammeters are very widely used in this country, while the later twisted strip instruments bid fair to come into extensive use. Aside from these may be mentioned the dispersion photometer, transmission dynamometer, and dynamometer coupling, several forms of dynamo and motor, and the secohmmeter, the first practical instrument for the measurement of self-induction.

In connection with Prof. Perry and the late Fleeming Jenkin, he did much of the work that resulted in the elaboration of the telpherage system, of which so much has been heard.

A large proportion of his professional papers have been written conjointly with Professor Perry; they may be found to the number of about ninety in the Proceedings of the Royal Society, the Philosophical Transactions, and the Journal of the Physical Society, and other periodicals; of these some of the most important are: "The Specific Inductive Capacity of Gases," "The Contact Theory of Voltaic Action," "A New Determination of the Ratio of the Electromagnet to the Electrostatic Unit of Quantity," "A Duplex Partial Earth Test," "Electricity as a Motive Power," "Experiments on the Heat Conduction of Stone," "On a Neglected Principle that May be Employed in Earthquake Measurements," "The Magic Mirror of Japan," "Electric Railways," "Measuring Instruments Used in Electric Lighting and Transmission of Power," "Economic Use of Gas Engines," "Electro-motors and their Government," "A New Form of Spring for Electric and other Measuring Instruments," "The Gas Engine Indicator Diagram," "The Most Economical Potential Difference to Use with Incandescent Lamps," "The Winding of Voltmeters," "Economy in Electrical Conductors," "Uniform Distribution of Power from an Electrical Conductor," "Modes for Measuring the Co-efficients of Self and Mutual Induction," "The Driving of Dynamos with very Short Belts," "Portable Voltmeters for Measuring Alternate or Direct Potential Differences," "The Magnetic Circuit in the Dynamo," and "The Efficiency of Incandescent Lamps with Direct and Alternate Currents." And still later we may mention the two brilliant papers on "The Chemistry of Secondary Cells" brought before the public within the past few months, and one of them published only last week in THE ELECTRICAL WORLD. Besides these Prof. Ayrton has contributed a large number of technical papers to the scientific periodicals of Great Britain.

Prof. Ayrton is an indefatigable worker in every department of electrical science, and, as may be seen from the list of papers just mentioned he is equally at home as the practical engineer and the theoretical scientist. Taken altogether his work in electricity has been most notable, and his present line of investigation bids fair to throw a flood of light into a rather dark corner of electro-chemistry.

Observations of a Constructing Electrical Engineer.

BY C. E. WOODS, E. E.

In reading the different papers devoted to the electrical interests one cannot help noticing that most of the matter published in them bears upon the theoretical side of the question, and that very little space seems to be given to the plain, common everyday side of it. Now while theorizing is necessary, it should be remembered that in addition to theoretical problems we have some very practical ones to solve, and I will try to present some of them in this article, taken from the standpoint of a constructing electrician, which is my humble vocation, and I think my brother engineers will say I am right. While I lay no claim to being an electrical expert, I have had considerable experience in construction work, and I am sorry to say my work comes a long way from being satisfactory to myself for reasons that I will present later on. First, what is a constructing electrician or electrical engineer? He is the medium through which electricity in its various forms is introduced to an ignorant public. He is the one who must put into satisfactory operation the electric plants for light and power purposes. He is the one who must carry out the plans of half a dozen different men to obtain the desired result. He must learn when to take care of and operate his system, whatever it may be. He must be ready for any and all emergencies, and is supposed to be infallible, but in this respect it sometimes proves to be a case of misplaced confidence. But, poor fellow, he has much to contend with, and much

trouble that is not of his own making, and the greatest of all is the everlasting desire of the American public for cheapness. This is a practical problem that some of the great and learned minds ought to endeavor to solve. It may be asked, what do you mean by cheapness? I mean the cheap material, cheap workmanship and cheap labor that electrical engineers are obliged to use. We have as good material in our market as could be desired, but people won't pay for it, at least as long as they can help it. I saw an article not long since in one of our leading papers telling how much better the material and work were in England than in America. Now, America has just as good material as can be procured, but American people won't pay for it as long as they are allowed to use cheap material; and just as long as the consumer can say what he shall pay and what kind of material shall be used in his particular installation will the electrical engineer be obliged to do poor work and use poor material. To be sure the insurance companies have taken it up to a certain extent, but of a truth it doesn't go very far. And so to sum it up, in short, inside wiring in this country is, generally speaking, more a matter of dollars and cents than good work and material. I would suggest that if people will not do any different of their own accord, some means ought to be devised by which they will be forced to. If the insurance companies cannot enforce it let some one introduce a bill carrying with it a set of rules and regulations for this purpose into the Legislature and see if something cannot be accomplished in that way.

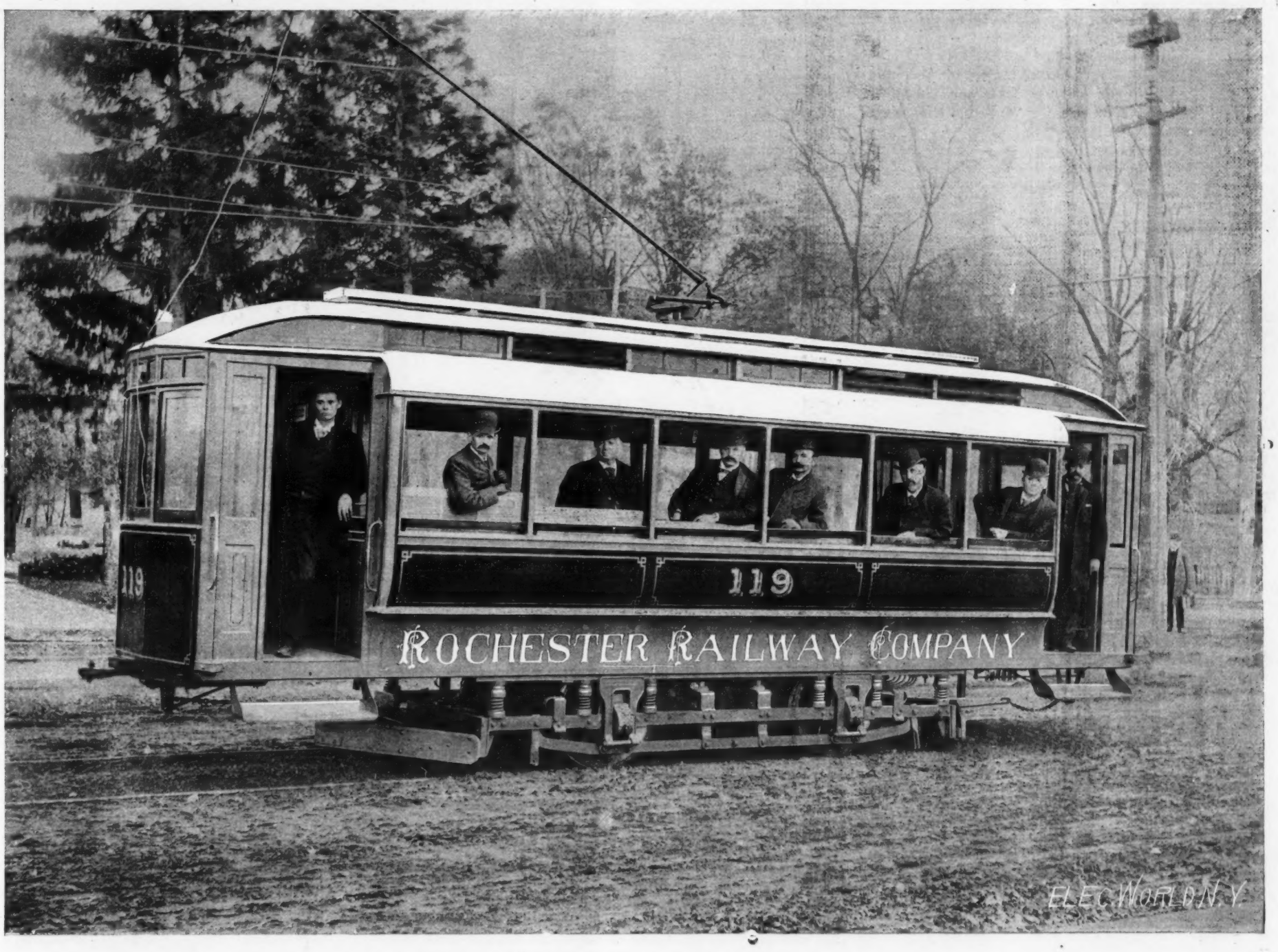
Now when it comes to line work it is something dreadful to think about. There are absolutely no rules relative to this branch of the work that can be enforced, except in some few local instances; and of all the cheap unsightly work that ever was done the average line construction of to-day is, I believe, the worst. It comes of course from close competition between the various systems in some instances, but not always, for often local companies put up their own line work under the supervision of a man who knows little or nothing about it, hoping thereby to save something. But by so doing they make a grand mistake, which they sooner or later find out to their sorrow. This state of things will exist as long as local companies and manufacturers of different systems can pursue their individual methods in the matter.

Electrical engineers would gladly do better work if their respective companies could get a price that would allow them to, and so this, like inside wiring, narrows itself down to a matter of dollars and cents. At present there seems to be no help for it, for no company can or will give a dollar for fifty cents; but if all companies were forced to bid on work and material of some standard quality it would then be a case of the survival of the fittest. The trouble is we have too wide a range of material, both as to quantity and quality, that we are allowed to use. This is the whole matter in a nutshell.

And now we come to the most vital and interesting point of all, namely, the care and management of electrical plants; and while some of the older and abler minds are working out some of the theoretical problems let us look at one or two practical ones. First we have to contend with the same mania for cheapness in both construction and labor. Of course we understand there are some splendidly equipped plants, and under the management of thorough electricians, but it is only in the larger cities. In most of the smaller towns the electrician, so-called, is usually a fellow who has learned all he knows from the electrical engineer while the plant was in process of construction for a period of three or four months. As long as he has no accidents and the plant does not need to be increased everything goes well. But after a little they commence to add to their work and then the trouble begins to brew. Those entrusted with the management commence to experiment and as a result they soon turn the plant into a failure, both electrically and commercially. Again, a plant is seldom found equipped with any portable instruments better than a five-dollar magneto, outside of those that belong to the system proper. Why? Because they cost money, and if the company had them there is no one connected with the plant that would know how to use them, and as long as individual companies can control these things so long must we put up with useless accidents, poor insulation, companies that don't make money and a general inefficiency all around. I sincerely hope that some of the electricians who are in a position to better this condition of things will ere long look this ground carefully over and see if something cannot be done. It is certainly good food for thought. One thing is certain: until some step is taken in this direction manufacturers of electrical apparatus need not expect to give the satisfaction they desire to, and central stations will not earn as much as they ought to earn.

The Rochester Street Railway.

We show in the annexed illustration an excellent view of one of the Short motor cars in operation on the Rochester Street Railway, which has been under equipment by that system during the past season. When in full operation this will constitute one of the largest street railway plants in the country, and is intended to be a model of good construction in every respect. The motor cars, as will be seen, are of the vestibule pattern, affording protection both to the passengers and to the driver in bad weather, and are very finely finished. Each car is driven by two 15 h. p. Short motors. These are mounted on special motor trucks, part being the well-known Peckham trucks having a wheel base of six feet six inches, and trucks of the Bemis make of a wheel base six inches shorter. The motors, as is now well known, are geared to the axle in the ordinary manner and supported much as in the systems now familiar to the public. The motors are series wound, and run in parallel on a constant potential circuit, as in most of the other systems. They are governed by a rheostat of a special construction. The Short Company originally started with a series system, which is now, for the most part, abandoned; but it retains the same general construction of machine as at first, using a Gramme armature of large diameter and the same arrangement of parts as in the Brush dynamos. The torque thus obtained is very powerful. There is comparatively little danger of burning out the armature coils, and the heating is but slight, owing to the unusually good ventilation. The cars in Rochester have given great satisfaction by reason of their reliability and smooth and steady running. The power station is now nearly completed, and will be one of the finest structures of its kind in the country. The dynamo room will be over 200 feet long, and the capacity of the machines will reach nearly 2,000 h. p. The car itself is shown at rest on one of its early trips, and the electrical fraternity will discover several familiar faces among the occupants. This is the largest of the street railroads on the Short system, and the success which has been attained is very creditable indeed to the company. It is interesting to note in this connection that Rochester is one of the most advanced cities in the country as regards its electric lighting and electric power industries. Her electric street railways, as will be seen, will soon rank among the first in extent and importance.



VESTIBULED CAR ON THE ROCHESTER STREET RAILWAY.

The Electromagnet.*

BY PROF. SILVANUS P. THOMPSON, D. SC., B. A., M. I. E. E.

POLARIZED MECHANISM; USES OF PERMANENT MAGNETS.

We must now turn our attention to one class of electromagnetic mechanism which ought to be carefully distinguished from the rest. It is that class in which, in addition to the ordinary electromagnet, a permanent magnet is employed. Such an arrangement is generally referred to as a *polarized mechanism*. The objects for which the permanent magnet is introduced into the mechanism appear to be in different cases quite different. I am not sure whether this is clearly recognized, or whether a clear distinction has even been drawn between three entirely separate purposes in the use of a permanent magnet in combination with an electromagnet. The first purpose is to secure unidirectionality of motion; the second is to increase the rapidity of action and of sensitiveness to small currents; the third to augment the mechanical action of the current.

(*a.*) *Unidirectionality of Motion.*—In an ordinary electromagnet it does not matter which way the current circulates; no matter whether the pole is north or south, the armature is pulled, and on reversing the current the armature is also pulled. There is a rather curious old experiment which Sturgeon and Henry showed, that if you have an electromagnet with a big weight hanging on it, and you suddenly reverse the current, you reverse the magnetism, but it still holds the weight up; it does not drop. It has not time to drop before the magnet is charged up again with magnetic lines the other way on. Whichever way the magnetism traverses the ordinary soft iron electromagnet, the armature is pulled. But if the armature is itself a permanent magnet of steel, it will be pulled when the poles are of one sort, and pushed when the poles are reversed—that is to say, by employing *a polarized armature* you can secure unidirectionality of motion in correspondence with the current. One immediate application of this fact for telegraphic purposes is that of duplex telegraphy. You can send two messages at the same time and in the same direction to two different sets of instruments, one set having ordinary electromagnets, with a spring behind the armature of soft iron, which will act simply independently of the direction of the current, depending only on its strength and duration; and another set having electromagnets with polarized armatures, which will be affected not by the strength of the current, but by the direction of it. Accordingly, two completely different sets of messages may be sent through that line in the same direction at the same time.

Another mode of constructing a polarized device is to attach the cores of the electromagnet to a steel magnet, which imparts to them an initial magnetization. Such initially magnetized electromagnets were used by Brett in 1848 and by Hjörth in 1850. A patent for a similar device was applied for in 1870 by Sir William Thomson and refused by the Patent Office. In 1871 S. A. Varley patented an electromagnet having a core of steel wires united at their ends.

Wheatstone used a polarized apparatus consisting of an electromagnet acting on a magnetized needle. He patented, in fact, in 1845, the use of a needle permanently magnetized to be attracted one way or the other between the poles of an electromagnet. Sturgeon had described the very same device in the *Annals of Electricity* in 1840. Gloesner claims to have invented the substitution of permanent magnets for mere armatures in 1842. In using polarized apparatus it is necessary to work, not with a simple current that is turned off and on, but with reversed currents. Sending a current one way will make the moving part move in one direction; reversing the current makes it go over to the other side. The mechanism of that particular kind of electric bell that is used with magneto-electric calling apparatus furnishes an excellent example of a polarized construction. With these bells no battery is used; but there is a little alternate-current dynamo, worked by a crank. The alternate currents cause the pivoted armature in the bell to oscillate to right and left alternately, and so throw the little hammer to and fro between the two bells.

(*b.*) *Rapidity and Sensitiveness of Action.*—For relay work polarized relays are often employed, and have been for many years. Here on the table is one of the post-office pattern of standard relay, having a steel magnet to give magnetism permanently to a little tongue or armature which moves between the poles of an electromagnet that does the work of receiving the signals. In this particular case the tongue of the polarized relay works between two stops, and the range of motion is made very small in order that the apparatus may respond to very small currents. At first sight it is not very apparent why putting a permanent magnet into a thing should make it any more sensitive. Why should permanent magnetism secure rapidity of working? Without knowing anything more, inventors will tell you that the presence of a permanent magnet increases the rapidity with which it will work. You might suppose that permanent magnetism is something to be avoided in the cores of your working electromagnets, otherwise the armatures would remain stuck to the poles when once they had been attracted up. Residual magnetism would, indeed, hinder the working unless you have so arranged matters that it shall be actually helpful to you. Now for many years it was supposed that permanent magnetism in the electromagnet was anything but a source of help. It was supposed to be an unmitigated nuisance, to be got rid of by all available means, until, in 1855, Hughes showed us how very advantageous it was to have permanent magnetism in the cores of the electromagnet. Here (Fig. 51) is the drawing of Hughes' magnet to which I referred in Lecture III. A compound permanent magnet of horseshoe shape is provided with coils on its pole pieces, and there is a short armature on the top attached to a pivoted lever and a counteracting spring. The function of this arrangement is as follows: That spring is so set as to tend to detach the armature, but the permanent magnet has just enough magnetism to hold the armature on. You can, by screwing up a little screw behind the spring, adjust these two contending forces, so that they are in the nicest possible balance; the armature held on by the magnetism, and the spring just not able to pull it off. If, now, when these two actions are so nearly balanced you send an electric current round the coils, if the electric current goes one way round it just weakens the magnetism enough for the spring to gain the victory, and up goes the armature. This apparatus then acts by letting the armature off when the balance is upset by the electric current; and it is capable of responding to extremely small currents. Of course, the armature has to be put on again mechanically, and in Hughes' type-writing telegraph instruments it is put on mechanically between each signal and the next following one. The arrangement constitutes a distinctive piece of electromagnetic mechanism.

(*c.*) *Augmenting Mechanical Action of Current.*—The third purpose of a permanent magnet, to secure a greater mechanical action of the varying current, is closely bound up with the preceding purpose of securing sensitiveness of action. It is for this purpose that it is used in telephone re-

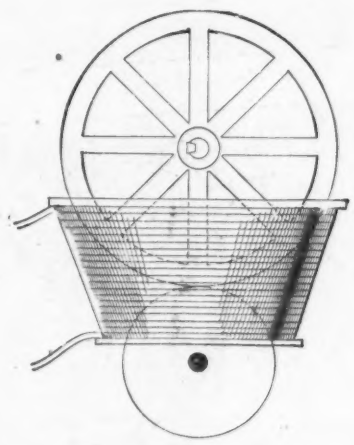


Fig. 72.—Nicklès' Magnetic Friction Gear.

ceivers; it increases the mechanical action of the current, and therefore makes the receiver more sensitive. For a long time this was not at all clear to me, indeed I made experiments to see how far it was due to any variation in the magnetic permeability of iron at different stages of magnetization, for I found that this had something to do with it, but I was quite sure it was not all. Prof. George Forbes gave me the clue to the true explanation; it lies in the law of traction with which you are now familiar, that the pull between a magnet and its armature is proportional to the square of the number of magnetic lines that come into action. If we take **N**, the number of magnetic lines that are acting through a given area, then to the square of that the pull will be proportional. If we have a certain number of lines, **N**, coming permanently to the armature, the pull is proportional to $\mathbf{N}^2$. Suppose the magnetism now to be altered—say made a little more; and the increment be called $d\mathbf{N}$; so that the whole number is now $\mathbf{N} + d\mathbf{N}$. The pull will now be proportional to the square of that quantity. It is evident that the motion will be proportional to the difference between the former pull and the latter pull. So we will write out the square of $\mathbf{N} + d\mathbf{N}$, and the square of **N** and take the difference.

Increased pull, proportional to $\mathbf{N}^2 + 2\mathbf{N}\cdot d\mathbf{N} + d\mathbf{N}^2$:
Initial pull, proportional to $\mathbf{N}^2$

Subtracting; difference is $2\mathbf{N}.d\mathbf{N} + d\mathbf{N}^2$.

We may neglect the last term, as it is small compared with the other. So we have, finally, that the change of pull is proportional to $2\,\mathbf{N}.\,d\,\mathbf{N}$. The alteration of pull between the initial magnetism and the initial magnetism with the additional magnetism we have given to it turns out to be proportional, not simply to the change of magnetism, but also to the initial number **N**, that goes through it to begin with. The more powerful the pull to begin with, the greater is the change of pull when you produce a small change in the number of magnetic lines. That is why you have this greater sensitiveness of action when using Hughes' electromagnets, and greater mechanical effect as the result of applying permanent magnetism to the electromagnets of telephone receivers.

ELECTROMAGNETIC MECHANISM.

There are some other kinds of electromagnetic mechanism to which I must briefly invite your attention as forming an important part of this great subject. Of one of these the mention of permanent magnets reminds me.

MOVING COIL IN PERMANENT MAGNETIC FIELD.

A coil traversed by an electric current experiences mechanical forces if it lies in a magnetic field, the force being proportional to the intensity of the field. Of this principle the mechanism of Sir W. Thomson's siphon recorder is a well-known example. Also those galvanometers which have for their essential part a movable coil suspended between the poles of a permanent magnet, of which the earliest example is that of Robertson (see *Encyclopædia Britannica*, ed viii., 1855), and of which Maxwell's suggestion, afterwards realized by d'Arsonval, is the most modern. Siemens has constructed a relay on a similar plan.

MAGNETIC ADHERENCE.

There are a few curious pieces of apparatus devised for increasing adherence electromagnetically between two things. Here is an old device of Nicklès, who thought he would make a new kind of rolling gear. Whether it was a railway wheel on a line, or whether it was going to be an ordinary wheel gearing, communication of motion was to be made from one wheel to another, not by cogs or by the mere adherence of ordinary friction, but by magnetic adherence. In Fig. 72 there are shown two iron wheels rolling on one another, with a sort of electromagnetic jacket around them, consisting of an electric current circulating in a coil, and causing them to attract one another and stick together with magnetic adherence. In Nicklès' little book on the subject there are a great number of devices of this kind described, including a magnetic brake for braking railway wagons, engines and carriages, applying electromagnets either to the wheels or else to the line, to stop the motion whenever desired. The notion of using an electromagnetic brake has been revived quite recently in a much better form by Prof. G. Forbes and Mr. Timmis, whose particular form of electromagnet, shown in Fig. 73, is peculiarly interesting, being a better design than any I have ever seen for securing powerful magnetic traction for a given weight of iron and copper. The magnet is a peculiar one; it is represented here as cut away to show the internal construction. There is a sort of horseshoe made of one grooved rim, the whole circle of coil being laid embedded in the groove. The armature is a ring which is attracted down all round, so that you have an extremely compact magnetic circuit around the copper wire at every point. The magnet part is attached to the frame of the wagon or carriage, and the ring-armature is attached to the wheel or to its axis. On switching on the electric current the rim is powerfully pulled, and braked against the polar surface of the electromagnet.

Forbes' arrangement appears to be certainly the best yet thought of for putting a magnetic brake on the wheels of a railway train.

Another, but quite distinct, piece of mechanism depending on electromagnetic adherence is the magnetic *clutch* employed in Gülcher's arc lamp.

REPULSION MECHANISM.

Then there are a few pieces of mechanism which depend on repulsion. In 1850 a little device was patented by Brown and Williams, consisting, as shown in Fig. 74, of an electromagnet which repelled part of itself. The coil is simply wound on a hollow tube, and inside the coil is a piece, *B*, of iron, bent as the segment of a cylinder to fit in, going from one end to the other. Another little iron piece, *A*, also shaped as the segment of a tube, is pivoted in the axis of the coil. When these are magnetized one tends to move away from the other, they being both of the same polarity. Of late there have been many ampèremeters and voltmeters made on this plan of producing repulsion between the parallel cores.

Here (Fig. 75) is another device of recent date, due to Maikoff and De Kabath. Two cores of iron, not quite parallel, pivoted at the bottom, pass up through a tubular coil. When both are magnetized, instead of attracting one another, they open out; they tend to set themselves along the magnetic lines through that tube. The cores, being wide open at the bottom, tend to open also at the top.

ELECTROMAGNETIC VIBRATORS.

Then there is a large class of mechanisms about which a whole chapter might be written, namely, those in which vibration is maintained electromagnetically. The armature of an electromagnet is caused to approach and recede alternately with a vibrating motion, the current being automatically cut off and turned on again by a self-acting brake. The electromagnetic vibrator is one of the cleverest things ever devised. The first vibrating electromagnetic mechanism ever made was exhibited here in this room in 1824 by its inventor, an Englishman named James Marsh. It consisted of a pendulum vibrating automatically between the poles of a permanent magnet. Later, a number of other vibrating devices were produced by Wagner, Neef, Froment and others. Most important of all is the mechanism of the common electric bell, invented by a man whose very name appears to be quite forgotten—John Mirand. How many of the millions of people who use electric bells know the name of the man who invented them? John Mirand, in the year 1850, put the electric bell practically into the same form in which it has been employed from that day to this. The vibrating hammer, the familiar push-button, the indicator or annunciator, are all of his devis-

* Cantor lectures, No. 4, concluded from The Electrical World, Dec. 6, 1890.

ing, and may be seen depicted in the specification of his British patent, just as they came from his hand.

Time alone precludes me from dealing minutely with these vibrators, and particularly with the recent work of Mercadier and that of Langdon-Davies, whose researches have put a new aspect on the possibilities of harmonic telegraphy. Langdon-Davies' rate governor is the most recent and perfect form of electromagnetic vibrator.

INDICATOR MOVEMENTS.

Upon the table here are a number of patterns of electric bells, and a number also of the electro-mechanical movements or devices employed in electric bell work, some of which form admirable illustrations of the various principles that I have been laying down. Here is an iron-clad electromagnet; here a tripolar magnet; here a series of pendulum motions of various kinds; here is an example of oblique pull; here is Jensen's indicator, with lateral pull; here is Moseley's indicator, with a coil-and-plunger, iron-clad; here is a clever device in which a disc is drawn up to better the magnetic circuit. Here, again, is Thorpe's semaphore indicator, one of the neatest little pieces of ap-

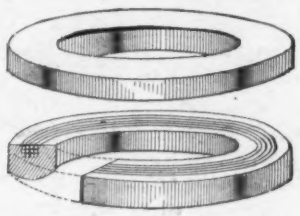


FIG. 73.—FORBES' ELECTROMAGNET.

paratus, with a single central core surrounded by a coil, while a little strip of iron coming round from behind serves to complete the circuit all save a little gap. Over the gap stands that which is to be attracted, a flat disc of iron, which, when it is attracted, unlatches another disc of brass which forthwith falls down. It is an extremely effective, very sensitive and very inexpensive form of annunciator. The next two are pieces of polarized mechanism having a motion directed to one side or the other, according to the direction of the current. From the backboard projects a small straight electromagnet. Over it is pivoted a small arched steel magnet, permanently magnetized, to which is attached a small signal lever bearing a red disc. If there is a current flowing one way then the magnet that straddles over the pole of the electromagnet will be drawn over in one direction. If I now reverse the current the electromagnet attracts the other pole of the curved magnet. Hence this mechanism allows of an electrical replacement without compelling the attendant to walk up to the indicator board. The polarized apparatus for indicators has this advantage, that you can have electrical as distinguished from mechanical replacement.

THE STUDY OF ELECTROMAGNETIC MECHANISM.

The rapid survey of electromagnetic mechanisms in general has necessarily been very hurried and imperfect. The study of it is just as important to the electrical engineer as is the study of mechanical mechanism to the mechanical engineer. Incomplete as is the present treatment of the subject, it may sufficiently indicate to other workers useful lines of progress, and so fitly be appended to these lectures on the electromagnet. In a very few years we

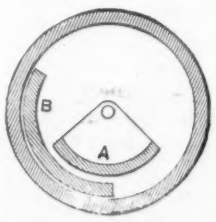


FIG. 74.—ELECTROMAGNETIC MECHANISM WORKING BY REPULSION.

may expect the introduction into all engineering shops of *electromagnetic tools*. On a small scale, for driving dental appliances, electromagnetic engines have long been used. Large machine tools, electromagnetically worked, have already begun to make their appearance. Some such were shown at the Crystal Palace, in 1881, by Mr. Latimer Clark, and more recently Mr. Rowan, of Glasgow, has devised a number of more developed forms of electromagnetic tools.

SUPPRESSION OF SPARKING.

It now remains for me to speak briefly of the suppression of sparks. There are some half dozen different ways of trying to get rid of the sparking that occurs in the breaking of an electric circuit whenever there are electromagnets in that circuit. Many attempts have been made to try and get rid of this evil. For instance, one inventor employs an air blast to blow out the spark just at the moment it occurs. Another causes the spark to occur under a liquid. Another wipes it out with a brush of asbestos cloth that comes immediately behind the wire and rubs out the spark. Another puts on a condenser to try and store up the energy. Another tries to put on a long thin wire or a high resistance of liquid, or something of that kind, to provide an alternate path for the spark, instead of jumping across the air and burning the contacts. There exist some half-score, at any rate, of that kind of device. But there are devices that I have thought it worth while to examine and experiment upon, because they depend merely upon the mode of construction adopted in the building of the electromagnet, and they have each their own qualities. I have here five straight electromagnets, all wound on bobbins the same size, for which we shall use the same iron core and the same current for all. They are all made, not only with bobbins of the same size, but their coils consist as nearly as possible of the same weight of wire. The first one is wound in the ordinary way; the second one has a sheath of copper wound round the interior of the bobbin before any wire is put on. This was a device, I believe, of the late Mr. C. F. Varley, and is also used in the field magnets of Brush dynamos. The function of the copper sheath is to allow induced currents to occur, which will retard the fall of magnetism, and damp down the tendency to spark. The third one is an attempt to carry out that principle still further. This is due to an American of the name of Paine, and has been revived of late years by Dr. Aron, of Berlin. After winding each layer of the coil, a sheath of metal foil is interposed so as to kill the induction from layer to layer. The fourth one is the best device hitherto used, namely, that of differential winding, having two coils connected so that the current goes opposite ways. When equal currents flow in both circuits there is no magnetism. If you break the circuit of either of the two wires the core at once becomes magnetized. You get magnetism on breaking, you destroy magnetism on making the circuit; it is just the inverse case to that of the ordinary electromagnet. There the spark occurs when magnetism disappears, but here, since the magnetism disappears when you make the circuit, you do not get any spark at make, because the circuit is already made. You do not get any at break, because at break there is no magnetism. The fifth and last of these electromagnets is wound according to a plan devised by Mr. Langdon-Davies, to which I alluded in the middle of this lecture, the bobbin being wound with a number of separate coils in parallel with one another, each layer being a separate wire, the separate ends of all the layers being finally joined up. In this case there are 15 separate circuits; the time constants of them are different, because, owing to the fact that these coils are of different diameters, the

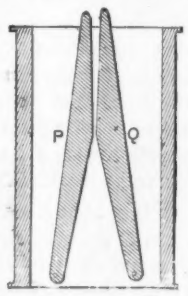


FIG. 75.—REPULSION BETWEEN TWO PARALLEL CORES.

coefficient of self-induction of the outer layers is rather less, and their resistance, because of the larger size, rather greater than those of the inner layers. The result is that instead of the extra current running out all at the same time, it runs out at different times for these 15 coils. The total electromotive force of self-induction never rises so high and it is unable to jump a large air-gap, or give the same bright spark as the ordinary electromagnet would give. We will now experiment with these coils. The differential winding gives absolutely no spark at all, and second in merit comes No. 5, with the multiple wire winding. Third in merit comes the coil with intervening layers of foil. The fourth is that with copper sheath. Last of all, the electromagnet with ordinary winding.

CONCLUSION.

Now let me conclude by returning to my starting point—the invention of the electromagnet by William Sturgeon. Naturally you would be glad to see the counterfeit presentment of the features of so remarkable a man, of one so worthy to be remembered among distinguished electricians and great inventors. Your disappointment cannot be greater than mine when I tell you that all my efforts to procure a portrait of the deceased inventor have been unavailing. Only this I have been able to learn as the result of numerous inquiries; that an oil painting of him existed a few years ago in the possession of his only daughter, then resident in Manchester, whose address is now, unfortunately, unknown. But if his face must remain unknown to us, we shall none the less proudly concur in honoring the memory of one whose presence once honored this hall wherein we are met, and whose work has won for him an imperishable name.

Final Fees in Patent Cases.

A Washington (D. C.) dispatch says: "The Attorney-General on the request of the Commissioner of Patents has rendered an opinion of special interest to inventors and patent attorneys. The effect will be to do away with the practice of postponing indefinitely the issuance of letters patent by neglecting to pay the final fees within the required six months, and then before the expiration of two years allowed by law, applying to have the application renewed. The Attorney-General holds that a patent cannot be allowed on any application for renewal not filed within two years after the allowance of the original application."

Magnetism and Recalescence.*

BY J. HOPKINSON, D. SC., F. R. S.

In my experiments, the results of which are published, *Phil. Trans.*, 1889, A, p. 443, I showed that recalescence and the disappearance of magnetizability in iron and steel occurred at about the same temperature. The evidence I then gave was sufficiently satisfactory, but did not amount to absolute proof of the identity of the temperatures. Osmond has shown that the temperature of recalescence depends upon the temperature to which the iron has been heated, also that it differs when the iron is heated and when it is cooled. He also showed that for some sorts of steel the heat is liberated at more than one temperature, notably that in steel with 0.29 per cent. of carbon heat is liberated when cooling at 720 degrees C. and at 660 degrees C., and that with steel with 0.32 per cent. carbon there is a considerable liberation of heat before the temperature is reached when this becomes a maximum. It appeared to be desirable to obtain absolute proof that the change of

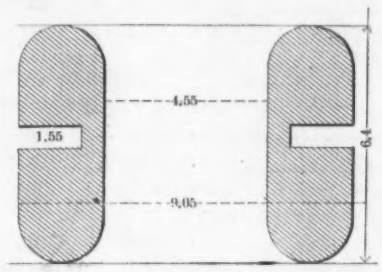


FIG. 1.

magnetic property occurred exactly when heat was liberated and absorbed, and to examine magnetically Osmond's two temperatures of heat liberation. I have not been able to obtain samples of steel of the size I used, showing two well marked temperatures of heat liberation and absorption, but I have a ring in which there is liberation of heat extending over a considerable range of temperature.

The samples had the form of rings of the size and shape indicated in Fig. 1. A copper wire was well insulated with asbestos and laid in the groove running round the ring, and was covered with several layers of asbestos paper laid in the groove. This coil was used for measuring temperature by its resistance. The whole ring was served over with asbestos paper and with sheets of mica. The secondary exploring coil was then wound on, next a serving of asbestos paper and mica, and then the primary coil, and lastly a good serving of asbestos paper was laid over all. In this way good insulation of the secondary coil was secured, and a reasonable certainty that the temperature coil took the precise temperature of the ring, and that at any time the ring was throughout at one and the same temperature. The whole was placed in an iron pot, and this again in a Fletcher gas furnace. Observations were made of temperature as the furnace was heating, and from time to time of induction. In each case the time of observation was noted. Similar observations were made as the ring cooled, the furnace being simply extinguished. We are thus enabled to compare directly at the same

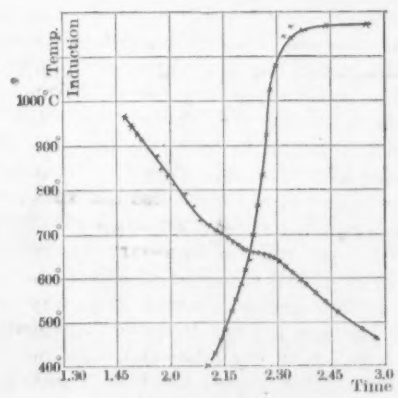


FIG. 2.

instant the condition of the same ring as regards magnetism and as regards temperature, and, therefore, qualitatively as regards its absorption or liberation of heat.

In Fig. 2 are the results for a ring containing 0.3 per cent. of carbon or thereabouts. In this case only a cooling curve was taken. It will be observed that there is a considerable liberation of heat, beginning at 2 hours 12 minutes, temperature 715 degrees C., and continuing to time 2 hours 22 minutes, temperature 660 degrees C.; being apparently slower at the end. This may, however, be only apparently somewhat slower as the furnace temperature would fall lower in relation to the ring. At time 2 hours 22 minutes, temperature 660 degrees C., the rate of liberation becomes much more rapid, so much so that the temperature for a time remains almost stationary. At time 2 hours 29 minutes, the liberation of heat appears to have ceased and the normal cooling to continue. Now, comparing the kicks of the galvanometer, which are proportional to the induction, we observe that the ring begins to be magnetizable at time 2 hours 12 minutes; its magnetic property increases till time 2 hours 22 minutes; after this point the magnetizability increases much more rapidly, and is practically fully developed at 2 hours 31 minutes. In this case the devel-

*Paper read before the Royal Society.

opment of magnetic property follows precisely the whole of the liberation of heat, observed both at the temperature of about 700 degrees C. and at 660 degrees C. We may therefore be certain that both at the higher and lower temperatures of recalescence there is magnetic change, and that the one is as much dependent on the other as the solid condition of ice is upon the liberation of heat when water solidifies. The two changes occur not only at the same temperature, but simultaneously. A considerable magnetizing force, 6.56, was taken, as it was expected and found that the magnetic property would then be more apparent when it was in the intermediate condition between the two temperatures of recalescence.

In Fig. 3 are the results of a ring containing 0.9 per cent. of carbon. In this case we have a curve of heating and of cooling with magnetic property for comparison, and also a second cooling curve to show the recalescence temperature when the heating had been higher. Unfortunately I had forgotten to record the magnetizing force. It was, however, much less than in the last case, probably less than unity. Looking at the curve, we see that there is a slight absorption of heat at time 11 hours 17 minutes, temperature 710 degrees C., with doubtful effect on the magnetism. At time 11 hours 27 minutes, temperature 770 degrees C., powerful absorption of heat begins and continues to time 11 hours 55 minutes, temperature 808 degrees C. It is between these times that the magnetizability is decreasing, and at the latter time that it finally disappears. The heating was continued to about 840 degrees C., and the flame was then put out. In cooling, heat is liberated at one point only, and in this case with a distinct rise of temperature. The recalescence begins at time 3 hours 47 minutes, temperature 750 degrees C., and it is precisely at this time that the ring begins to be magnetizable. The recalescence continues to time 4 hours 8 minutes, and at this time, and not before it, the magnetizability practically attains a maximum. Before the last portion of the curve the ring was heated to 966 degrees C. Here no observations were made magnetically. This part of the curve, therefore, only shows the effect of higher heating in lowering the temperature of recalescence.

These experiments show that the liberation and absorption of heat, known as recalescence, and the change in magnetic condition, occur simultaneously. Also that in the case of steel with 0.3 per cent. of carbon both temperatures of liberation of heat are associated with change of magnetic condition.

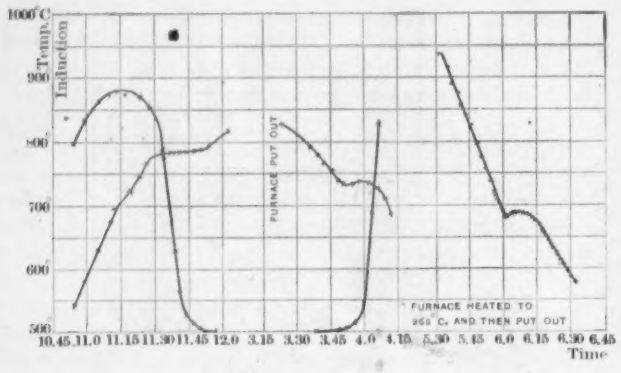
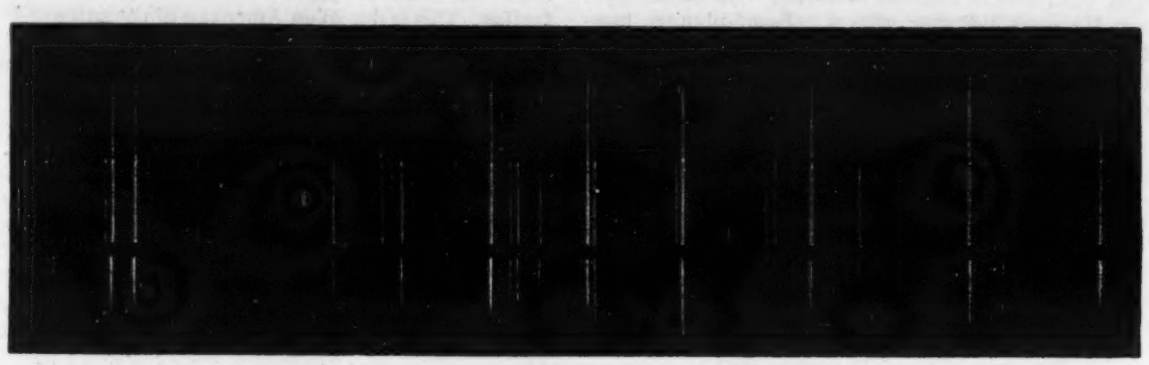


FIG. 3.



PHOTOGRAPH OF IRON SPECTRUM.

Motion of Atoms in Electric Discharges.*

BY JOHN TROWBRIDGE.

The application of spectrum analysis to the measurement of the approach or recession of a star in a direction directly away or directly toward an observer's eye is generally regarded as one of the greatest achievements of modern science. Experiments upon the oscillating discharge of electricity led me to reflect whether the method which has been used in star observation might not be employed to test the question whether the atoms of metals of the terminals between which the oscillating discharge passes are conveyed to and fro by the oscillating discharge, or whether they are shaken, so to speak, by the discharge so that they emit to the ether the ripples which appeal to our senses as light and heat. No mention is made here of a convection effect, which would take place too slowly to give a spectroscopic effect.

After I had made the experiments which I will shortly describe, and while I was in doubt whether to publish my results, a paper by Prof. J. J. Thomson, director of the Cavendish Laboratory, Cambridge, England, appeared in the August number of the *Philosophical Magazine* (1890), "On the Velocity of the Transmission of Electric Disturbances," which contains the following passage:

"The very rapid rate with which the electric discharge is propagated through a rare gas compels us to admit that the electricity is not carried by charged atoms moving with this velocity. For if it were, then if the discharge were to take place in air at atmospheric pressure between two parallel plates one centimetre apart, charged to a potential difference of approximately 30,000 volts, the kinetic energy which would have to be communicated to the atoms to make them move with this velocity would be greater than the original potential energy of the charged plates, assuming that the charge on each atom is that deduced from electrolytic considerations."

The unusual dispersion afforded by a Rowland concave grating led me to test this hypothesis in as far as it relates to the question: Are the molecules of metals carried with the oscillations of electricity from terminal to terminal between which the oscillations take place?

A circuit of wire giving a suitable value of self-induction was arranged in connection with a series of Leyden jars. The time of oscillation was calculated from the well-known formula $t = \pi \sqrt{LC}$, in which L is the value of the self-induction of the circuit, C the capacity of the Leyden jars. Preliminary examination of the electric spark taken through this circuit with a revolving mirror showed that the discharge was an oscillatory one. Two different values of self-induction were employed. One gave the duration of a double oscillation $t = .0000003$ of a second, the other gave $t = .00000024$ of a second.

If we denote by V the velocity of light, λ and λ_1 wave-lengths, S the speed of approach of the atom, we shall have $\lambda_1 = \lambda\left(\frac{V}{V+\delta}\right)$. The distance across which the oscillations took place is six millimetres. Calculation shows that if the iron atoms were conveyed to and fro between the terminals, a broadening of the iron lines in the spectrum would result, which could be readily detected. The broadening might amount to a space equivalent to a whole tenth-metre.

The oscillating spark passed between two iron terminals. One of these terminals was hollow. The hollow terminal was placed in a line perpendicular to the slit of the spectroscope, so that the oscillation of the spark should be toward and away from the slit. If, therefore, the iron atoms moved to and fro with the oscillations of electricity across the air-gap, a displacement of the iron lines in the spectrum of the metal would result. There would be both a displacement toward the less refrangible end, caused by the recession of the atom, and one toward the more refrangible end of the spectrum, caused by the approach of the atom. The great amount of dispersion offered by a concave grating of 20,000 lines to the inch enabled me to easily detect a movement equivalent to a tenth-metre. I accordingly took a photograph of the iron lines with the terminals in the position I have described, and on the same plate immediately above this photograph a comparison photographs was taken with the terminals parallel to the slit. In this case the iron atoms did not make their proposed excursions away toward the slit, and therefore no displacement of the spectrum lines was to be expected.

The photographic plate was exposed in the neighborhood of the great H-lines. A movable shutter enabled me to expose different portions of the same plate without changing any adjustment of the apparatus. The resulting photographs showed no displacement of the iron lines. The iron lines in the two photographs met exactly (continued in an unbroken line across the double photograph), and were of the same breadth throughout their extent (see figure).

The conclusion seems to be a strong one that the electrical oscillations do not carry the atoms of metal with them—in spark discharges. The atom is merely shaken up and caused to emit the vibrations or subsidiary ripples, which appeal to our senses as light and heat, while the electrical waves pass on without conveying the atoms.

*From the *Philosophical Magazine*.

Resistance Coils and Boxes, Their Construction and Use.

BY CHARLES P. FREY, CHIEF ELECTRICIAN, GREELEY ELECTRICAL LABORATORY.

I.

Superficially considered, the construction of resistance coils would seem an exceedingly simple matter. Yet if accurate results are to be secured with them, there are many important details to be taken into consideration, and before a reliable rheostat is finished much time and careful work is involved.

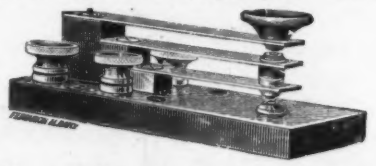
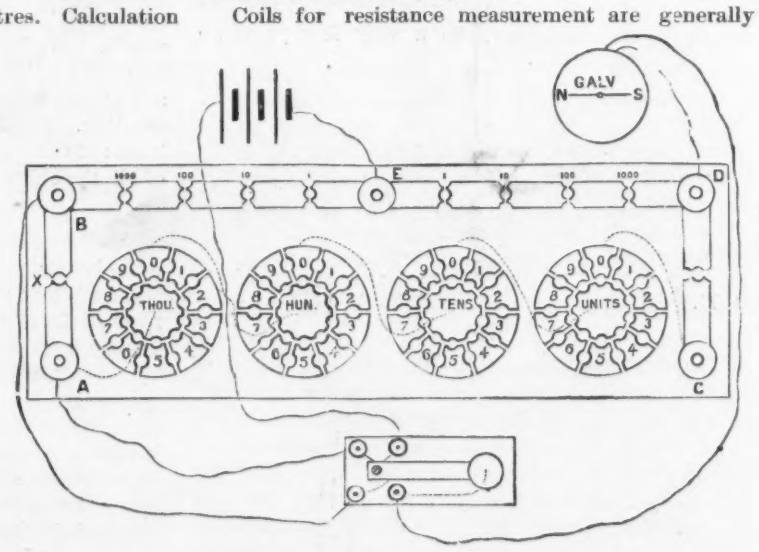


FIG. 3.—KEY FOR RESISTANCE BOX.

Coils for resistance measurement are generally constructed of either German silver, or platinum silver alloy wire, insulated with a double covering of silk. There has been much discussion concerning the material of which the wire should be composed, and the question is not yet settled. German silver has the advantage of being the cheaper composition, and it is said is less liable to vary in resistance with time than platinum silver alloy, which has a somewhat lower temperature coefficient.

Different sized wires are used for coils of high and low resistances, the sizes used generally ranging from Nos. 18 to 40 (B. and S. gauge). After being wound on spools and roughly adjusted, the coils should be immersed in a hot mixture, the chief ingredient of which is paraffine, in order that the air between the layers of wire may be expelled. A more thorough method consists in placing the coils, together with the containing vessel, under the receiver of an air pump and rarefying the air. This opera-



FIGS. 1 AND 2.—RESISTANCE COIL BOX AND DIAGRAM OF ITS CONNECTIONS.

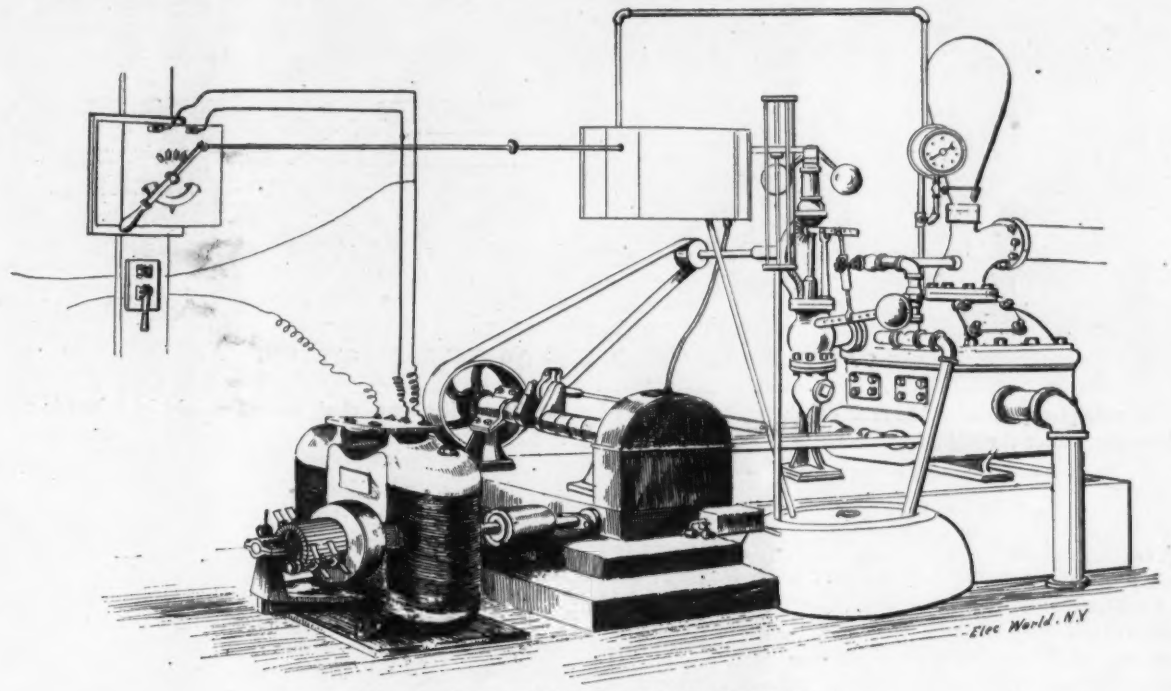
tion causes the bubbles of air which ordinarily will remain between the layers to expand and rise to the surface. After cooling the coils are placed in a "box" provided with proper terminals, binding-posts, plugs, etc., and are then in condition for final adjustment at temperature. Probably the best form of resistance box is that of the "dial-pattern," which is here illustrated. Fig. 1 shows the general appearance of the instrument, while Fig. 2 furnishes a diagram of connections.

The coils are connected under the dials and "arms" of the bridge, an arrangement which permits the operator to vary the resistance by moving *a single plug in each dial.* There are four dials, under each of which are nine coils. The coils under the first dial are ohms, giving nine ohms in series. Under the second dial are tens, giving 90 ohms in series. Under the third, hundreds, and under the fourth, thousands. (See Fig. 2). The segments on the dials are numbered, and are provided with two sets of plug holes. Any number of coils can be used in series, or a single coil can be selected and used separately, the others being plugged out.

It is noteworthy as an instance of the extreme care with which these resistance coils are calibrated, to mention that, in adjusting this box at the manufacturer's laboratory, the resistance of the dials, bars, and connections from one dial to another has been allowed for.

The brasswork and inner copper connections, although constructed of materials of great area and conductivity, have necessarily a slight resistance. The resistance of the dials, etc., between *A* and *C*, with all plugs at zero, is approximately $\frac{1}{2000}$ of an ohm. Now this resistance would be insignificant when a 1,000 ohm coil is used, but is of importance when a one-ohm coil is being adjusted. The resistance to be measured, being necessarily connected with the binding posts *A* and *B*, or *C* and *D*, it follows that the resistance of the *first* one-ohm coil on the unit dial must be one ohm *minus* the resistance of the brasswork, segments, plugs, etc., from *A* to *C*, in order that when a plug is placed in No. 1 on the unit dial a resistance which is exactly one ohm between the binding posts *A* and *C* will be obtained. But to secure this the resistance of the *first* unit coil on the dial is actually less than one ohm *in wire.* If now the second coil on the unit dial were adjusted in a like manner, without taking the resistance of the brasswork into consideration, it also would have a resistance in wire of precisely that of the first coil, and when the two were used in series (assuming the resistance of the box to be $\frac{1}{2000}$ ohm), they would measure 1.998 ohms. The same results would be obtained with the remaining seven coils. To prevent this shortage, the resistance of the dials, connections, etc., is determined between *A* and *C*, with all plugs at *O*. A resistance equivalent to this is added to the resistance of the standard coils *after adjusting the first coil under each dial.* Hence, the resistance of the first coil on the unit dial is 1 ohm minus $\frac{1}{2000}$ of an ohm; the second, 2 ohms minus $\frac{1}{2000}$ of an ohm; the third, 3 ohms minus $\frac{1}{2000}$ of an ohm, and so on, $\frac{1}{2000}$ of an ohm being necessarily added to the resistance of the first coil, owing to the resistance of the brass work, etc., before explained; it follows that the resistance between the binding posts will be correct. When the coils are to be used in series, a plug is placed in one of the *inner* rings of plug holes. An infinite resistance is secured by removing a plug entirely from any of the dials. To plug out an entire dial, the plug is placed at *O*. The range of this instrument is from $\frac{1}{1000}$ to 9,999,000 ohms. Each coil on the four dials is separately adjusted by direct comparison with a standard coil, immersed in water at the proper temperature. When arranged for resistance measurement as shown on Fig. 2, the resistance to be measured must be fastened at *X*, connecting with the double binding posts *AB*. In so using, a plug is put in the plug hole between *C* and *D*. An additional resistance can however be introduced at *CD*, the hole then being left unplugged. If it is more convenient, all measurements may be made at *CD*. When this is desired, *X* is plugged out and the wire from the double key to *A* is shifted to *C*. This is the only necessary change, and can be quickly accomplished by introducing a double point switch, the arm of which is connected by a wire with the contact key, and the two points of the key to the binding posts *A* and *C*. The coil to be measured may then be inserted at either *A B* or *C D* without changing connections by simply moving the arm of the switch. The only precaution in using a switch is to employ one which has a hard rubber base, with the contact points tolerably far apart. The coils are adjusted at the given temperature and are correct within one part in 10,000 or $\frac{1}{100}$ of one per cent. When measuring resistances with a dial box, it is a good plan to place a plug in one of the dials, introducing a resistance which is as near that being measured as judgment or guesswork suggests. If the plugged resistance is too small "exhaust" that dial by at once placing the plug in the ninth hole, and repeat the operation. If still too small, return the plug to *O* and repeat the operation with the next higher dial. By this method, a resistance can be rapidly located, as for instance greater than 400 ohms, and less than 500 ohms. In this instance leave the plug at 400 and add 90 ohms by placing the plug in the 10 ohm dial at No. 9, the box now reading 490 ohms. If still too small, we know at least that the unknown resistance lies between 490 ohms and 500 ohms, because we learned from a previous test that it is less than 500 ohms. The unit dial is therefore in demand, and we can very soon determine the resistance sought for by having 490 in position, and adding nine ohms, giving a total of 499 ohms. If this is too large, shift the unit plug until the resistance is determined to its nearest ohm, or if more precise measurement is desired, use a proportional bridge.

They key used is of the double-contact variety illustrated in Fig. 3. Galvanometers suited for resistance measurements with this box may be of a variety of designs, and will be explained in detail in another article.

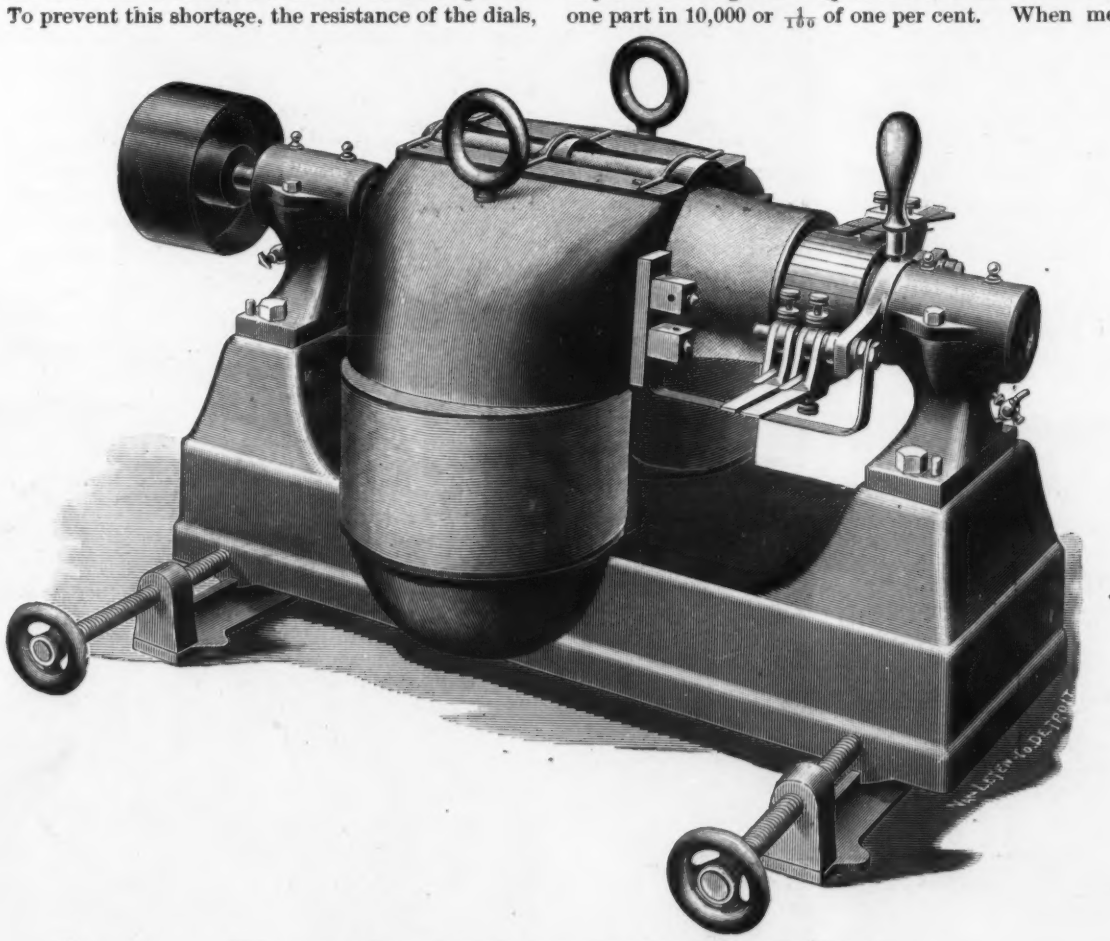


CARD MOTOR RUNNING AN ELEVATOR.

A New Electrical Elevator.

A very neat application of the electric motor to driving the pumps of a hydraulic elevator is shown in the annexed illustration. It has been recently installed in one of the large office buildings in Cincinnati by the Card Electro Motor and Dynamo Co. The arrangement of the plant is seen at a glance. A five h. p. Card motor is coupled with a worm-gearing special type of McGowan pump; the worm is directly upon the armature shaft, which makes 1,400 revolutions per minute, and drives the pump 50 strokes during the same time. The pump draws from a cistern filled from the city main, and forces the necessary water to the roof tank 100 feet above; this has a capacity of 1,200 gallons. Up to the installation of this plant the elevator had been operated direct by city water pressure, and the cost exceeded $35 per month. At the present time by the use of electric power this has been reduced to about $20 per month, a saving that will very soon pay for the installation, while the service is much improved, and no special attendant is required, for the entire apparatus is automatic in its action.

About 50 gallons of water are required for each full trip of the elevator, and when the water in the roof tank is lowered to a certain point, the action of a float moves a switch that gradually cuts the motor into circuit and causes the pump to fill the tank until it is automatically shut off by the float. An automatic device prevents the melting of the fuses in case the current should be suddenly cut off and quickly turned on again from the central station when the switch happened to be open, thus avoiding all chance for an interruption of the service. The operation of the plant has been satisfactory from the very first, and it is worthy of special notice on account of the very considerable saving that has been effected.



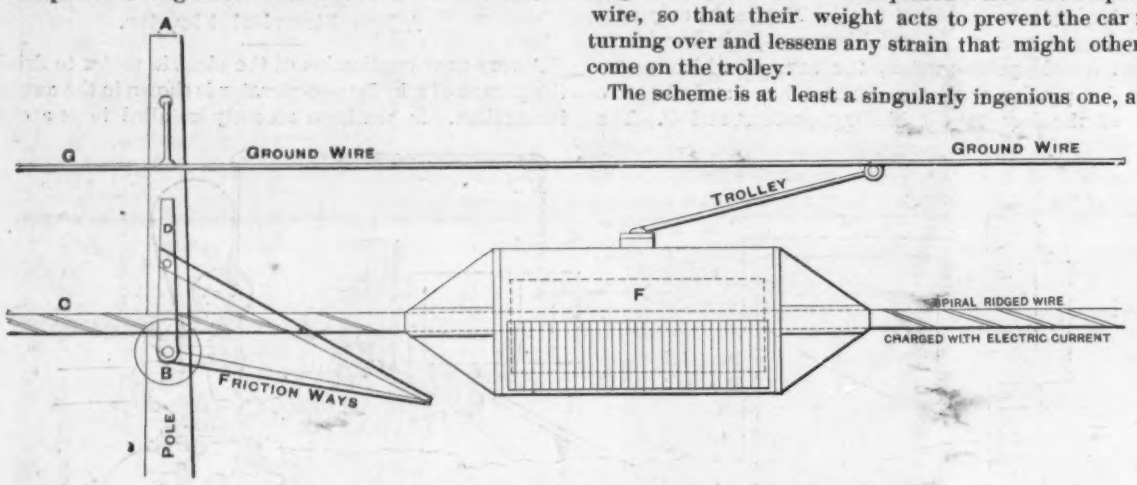
NEW DYNAMO OF THE DETROIT MOTOR COMPANY.

A New Dynamo.

We give herewith a cut of a newcomer among dynamoss designed by Mr. H. H. Blades of the Detroit Motor Company, by whom it is manufactured. It will noted be that this machine, which is built of various potentials for electric light and power service, belongs to the inverted horseshoe type of construction, but is noticeably low, looking almost squat from the massiveness of the pole-pieces and yoke, and the small height of the machine. The magnetic circuit thus obtained is very short and the magnetic resistance consequently low. The armature is of great length compared with its diameter, and is, of course, drum-wound. The whole dynamo is very solidly constructed, is furnished with self-oiling bolt bearings and independently adjustable brush holders, and the metallic parts are carefully finished. It appears to be one of the solid, substantially made, serviceable dynamo, that are now being manufactured at various places throughout the country. There is so little that is radically new in dynamo construction that the most that can be said of the average machine is that it is well designed. We have no efficiency test at hand, but from the general construction the electrical and mechanical losses could not be large.

The generator will be manufactured in 18 sizes, from one of 1,100 watts to one with a capacity of 160,000 watts. The 80,000-watt machine weighs 13,000 pounds. It gives

145 ampères at 550 volts, running at a speed of 480 revolutions per minute. The magnetizing current at 550 volts is 1.2 ampères. The armature core of the 100 h. p. machine is 12 inches in diameter and 26 inches long. It is made up of 850 charcoal iron discs, separated by paper, the oxide having first been removed from the surface of the iron. The magnet cores are of softest forged iron. A clearance hole is bored through the centre of each magnet. Through this hole passes a long bolt which screws into the bottom



CAR AND LINE OF OVERHEAD TELPHER SYSTEM.

of the pole-piece. The other end of the bolt is fastened with a nut under the yoke-bed.

An Overhead Telpher System.

A correspondent at Rochester, N. Y., sends an exceedingly ingenious scheme for electrical rapid transit, a sort of modified telpher arrangement that in its mechanical peculiarities is quite ingenious. In these days when the ingenuity of inventors is being turned towards devising similar schemes, the novelty of the present one awakens an interest quite independent of its comparative usefulness. The cut gives a complete idea of the arrangement intended to be adopted. It is, as will be seen, an overhead telpher system carrying a pointed car. In the figure *A* is an ordinary telegraph pole which supports the wire arrangement. Along the pole line are strung two wires, one of them an ordinary conductor of copper or iron, the other, which is the working conductor, entirely unconnected with the wire first mentioned, and supported at intervals on insulated wheels, of which *B* is one. The peculiarity of this working conductor *C* consists in the fact that it is not of circular section, but forms a screw of considerable pitch. *D* is a guard on one side of the pulley for the purpose of preventing this working conductor slipping off. To this guard and to the pole are attached arms or friction ways composed of wood or other insulating material, and fitted to catch the electrical car as it approaches the pulley and give it a gradual ascent sufficient to clear the pulley freely. On a single track line an additional pair of friction ways would be provided pointing in the opposite direction. The car is cylindrical in shape, provided with pointed ends to lessen the air resistance, and instead of being driven on wheels is driven through the medium of the coarse thread upon the working conductor. *E* is a cross section of the cylindrical motor, showing the channel in the centre through which the wire *C* passes. The motor is in the interior of the cylindrical car and solid with it, the armature being parallel to the axis of the car. The armature spindle is hollow, forming a nut adapted to run on the thread formed by the conductor *C*. On the upper side of the cylindrical car is a trolley, with guides if necessary to keep the car from turning over, running upon the plain wire *G*, which serves as the return.

The operation of the apparatus is obvious. The current passes from the working conductor to the nut in the armature spindle, which may, if necessary, be insulated on the spindle proper, thence through armature and fields to the trolley and so to the return wire. The revolution of the armature draws the car forward, while the field magnets, being solid with the car, are prevented from turning over by the long lever arm of the trolley and the guides which may accompany it. In addition, as will be seen from *F*, which shows a longitudinal section of the car, the field magnets of the motor are placed below the suspending wire, so that their weight acts to prevent the car from turning over and lessens any strain that might otherwise come on the trolley.

The scheme is at least a singularly ingenious one, and it can be readily seen that means might be taken to render the passage of the car over the wheels supporting the working conductor easy. A resistance could be arranged in the return wire in the vicinity of each pole so as to slacken the speed of the car as it reached the friction rollers. Similar resistance controlled, if need be, at a distance would furnish means for slowing down at the end of a run, thus making the arrangement of the apparatus entirely automatic. The efficiency would probably not be high, but the arrangement is certainly very simple, and at least as practicable as numerous other electrical rapid transit systems now before the public. Its special design is to carry mail matter and other like packages at a considerable rate of speed, and the motor can then be run at almost any speed desired, so that it may be easily constructed for quite a high efficiency. In fact this would differ from most other telpher systems in requiring a high motor speed, the higher the better. Indeed, an ordinary motor running at 1,500 to 2,000 revolutions would be quite incapable of giving it the speed desired. This rapid transit system may be commended to those who are racking their brains to find new and unusual forms of applying electrical power. It has the merit of great ingenuity, and is certainly not less efficient than some systems which have been proposed in a much more pretentious manner.

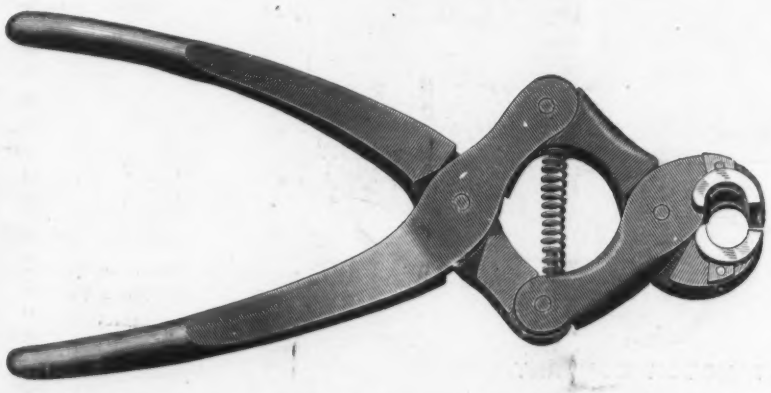
New Interior Conduit Coupling.

The Interior Conduit and Insulation Company, engaged in the business of manufacturing interior conduits, is continually striving to simplify the methods of construction of its system and to cheapen the cost of its goods. One of the most striking examples of its energies in this direction is to be found in the new coupling or joint which we illustrate on this page.

The methods heretofore employed for making joints have been found satisfactory, but in order to insure perfect work great care had to be exercised on the part of the workman, and it is with the idea of remedying this that the new coupling has been designed and placed upon the market.

The new joint will supplant the threaded coupling and entirely dispense with the use of the threading tool and cementing compound. The sleeve is made of soft galvanized iron, and being of a slightly larger diameter than the tube itself fits snugly upon it. The tool, which is made in the form of a pair of pliers, serves to press the two slight corrugations upon the outside of both halves of the sleeves and into the body of the tube, but does not in the least injure the latter or alter the internal diameter at that point. Joints so made are impervious to moisture and have great strength. By the new method joints may be made upon the floor or bench and the lengths of the tubing fitted with safety to the wall or ceiling without fear of straining or opening the joints.

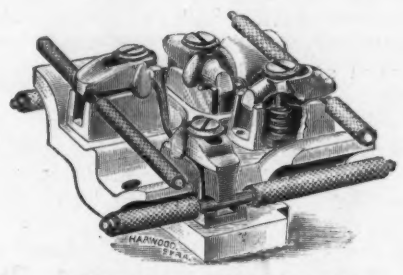
SECTION OF TELPHER CAR.



NEW JOINT AND JOINT TOOL FOR INTERIOR CONDUITS.

Seymour's Porcelain Fuse Block.

A very complete porcelain fuse base is shown in the accompanying illustration. One of its special features i



SEYMOUR'S FUSE BLOCK.

the provision made for securing a thoroughly tight contact at the binding screws at all times. The way in which this is done is well shown in the cut. Spiral springs are provided as shown so that when the binding screws are set up tight an even and durable contact is secured. The brasswork of this cut-out block is mounted upon the best of porcelain made by Pass & Seymour, of Syracuse, N. Y. The steel spiral springs are so applied that they will not be heated by the current and will always insure a good connection.

The Vetter Testing Set.

A neat and compact little instrument for the testing of circuits, batteries, etc., is shown in the accompanying illustration. The complete instrument, which is made by J. C. Vetter & Co., of this city, is contained in a polished hardwood case, at the back of which, as seen in the illustration, is the dry battery. When put in place the cell makes spring contact with the terminals of the galvanometer coil. A contact key is provided for closing the circuit when the instrument is in use, and a switch is also added by means of which a coil is thrown into circuit which converts the instrument from an ordinary testing set into a mil-ammeter for use in measurement. A suitable appliance is provided for lifting the needle from its bearing and thus holding it in a stationary position. The containing case is of a convenient size for the pocket.

The VETTER
PATENT DRY CELL
Testing Set and Elect. Gauge.
FOR TESTING LINES, BATTERIES ETC.
ALWAYS READY FOR USE
A COMPACT, RELIABLE & ECONOMICAL INSTRUMENT
J. C. VETTER & CO. N.Y.

VETTER'S TESTING SET.

Western Union's Quarterly Statement.

The directors of the Western Union Telegraph Company, at their regular quarterly meeting last week, declared the usual dividend of 1¼ per cent., payable on Jan. 15 to stockholders of record on Dec. 20. The statement submitted by President Green showed that, while the estimated net earnings for the quarter ended Sept. 30 were $2,000,000, the actual revenue was $2,000,731. The approximate statement for the current quarter, based upon partially completed returns for the past and estimates for the balance of this month, compares as follows with the actual returns for the corresponding quarter last year: Net revenues, $2,000,000; surplus October 1, $10,733,832. an increase of $1,425,624; total, $12,733,832, an increase of $1,425,624; interest and sinking fund, $242,483, an increase of $8,633; balance $12,491,349, an increase of $1,416,991; dividends, $1,077,399, a decrease of $646,451; surplus, $11,431,950, an increase of $2,081,413. The decrease in

the amount of dividends paid is due to the fact that for the quarter ended Dec. 31, 1889, an extra dividend of 4 was declared, amounting to $646,432.

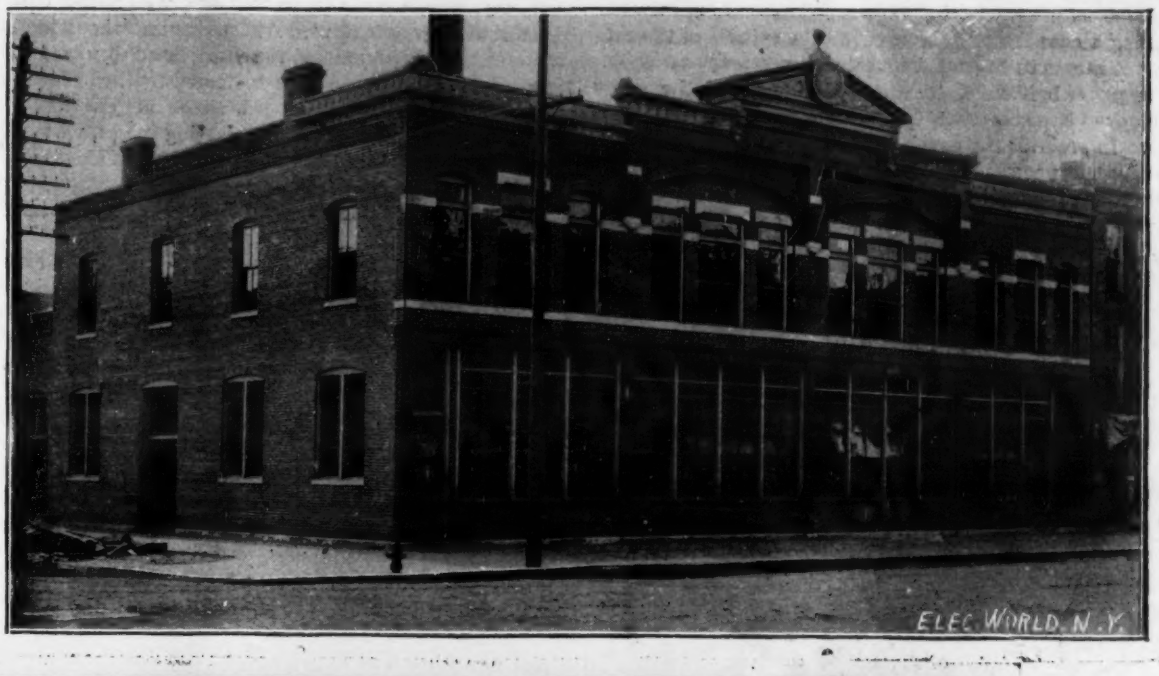
Light and Power Station at Springfield, Ill.

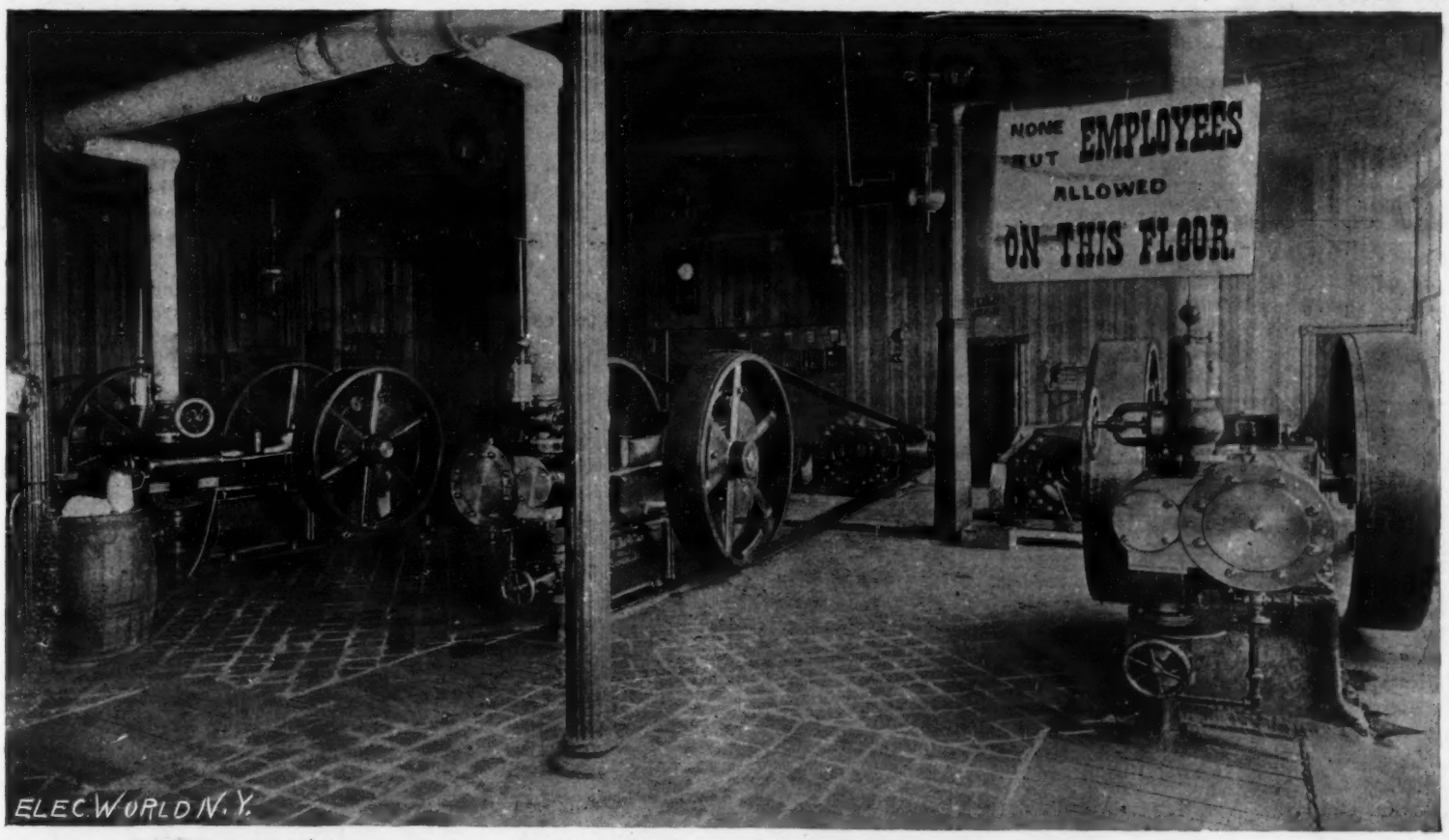
The annexed illustrations will give a good idea of a well arranged and successful central station of moderate size. It is located at Springfield, Ill., and was erected by the Springfield Electric Light and Power Company a little over a year ago to replace the old station which had seen some years of service. The lights were transferred without a shut down from the old system to the new, and the station has since then been in very successful operation.

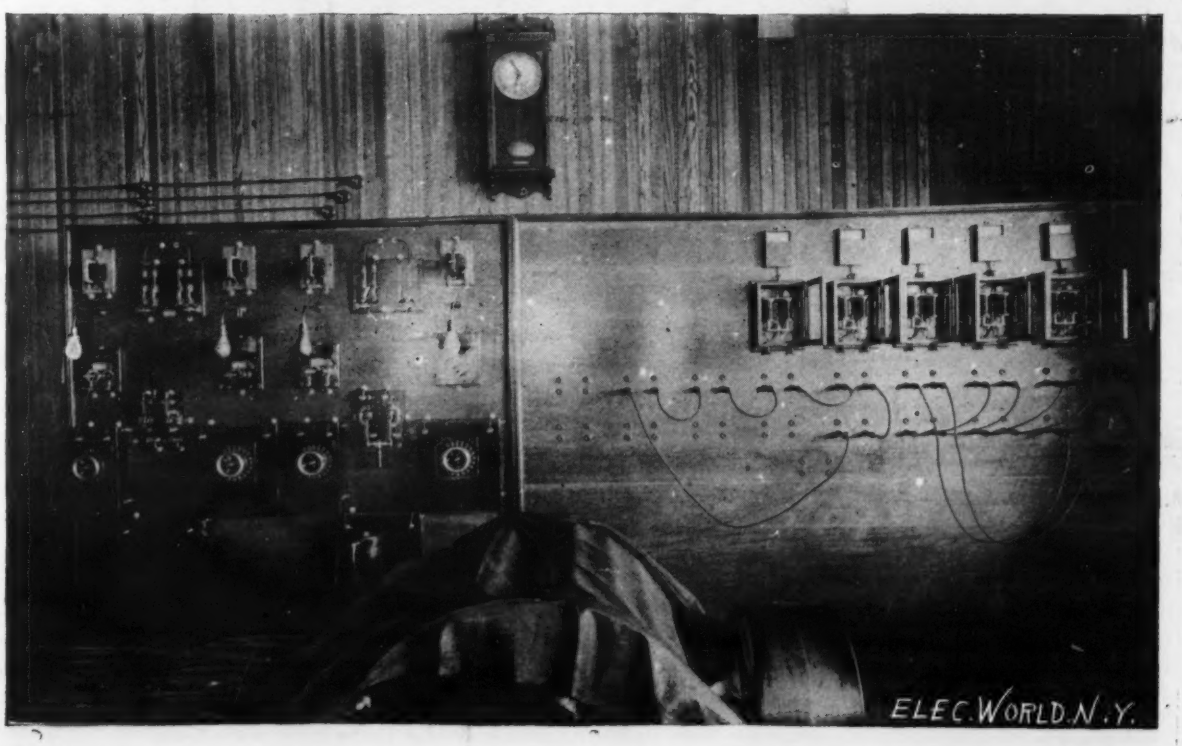
The building itself, shown in Fig. 1, is neatly designed, and the especial feature is the freedom with which light is admitted, nearly the entire front of the dynamo room being of glass. The upper story has the superintendent's office, repair shops, and the miscellaneous rooms; while on the ground floor is the dynamo and engine room. It is of considerable size, 80 × 54, with a tiled floor and neatly finished in pine. Fig. 2 gives an excellent idea of its interior. Four of the seven engines are shown coupled to their appropriate dynamos. All these engines are of the Ideal type manufactured by A. L. Ide & Son; they are each of 125 h. p., and drive at present five 50-light Thomson-Houston arc machines, two 500-light Thomson-Houston alternators, a 50 h. p. Royal generator for the power circuit, and two 70,000 watt Thomson-Houston railway dynamos. Fig. 3 shows two of the five switchboards for the regulation of the arc and incandescent circuits. The railway generators, not shown in the cut, have, of course, a switchboard of their own, and two others are used for different parts of the incandescent service. One of the features of the building is the system of ventilation for preventing over-heating of the dynamos. A flue runs along under the dynamo room with pipes opening right at the end of each machine; a little Sturtevant blower operated by a motor put on the arc circuit keeps a constant current of air circulating about the armatures of all the dynamos, so that even in the hottest weather there is little danger of over-heating.

The wiring, for which okonite wire is used throughout, is concealed under the floors with proper precautions against crosses, and all the wires leave the building through the distributing tower at its top. A full set of fire apparatus is in use in the building, so that at any moment fire plugs can be thrown into service.

The boiler room contains a battery of seven boilers, and special arrangements are made for bringing in the coal on a tramway and dumping it directly in front of the boilers. A glance at the cut of the dynamo room shows its general arrangement better than any description. All in all, this is a remarkably neat plant, and reflects great credit on the enterprise and foresight of the company. The day for temporary and cheaply-constructed stations is now past, and it is the part of wisdom to use only good materials and spare no pains to make an installation complete in all its details, and so thoroughly constructed that repairs will not come in to lessen dividends and cause unsatisfactory service.







BUILDING, DYNAMO ROOM AND SWITCHBOARD OF CENTRAL STATION AT SPRINGFIELD, ILL.

The Electric Motor to Supersede the Locomotive.

Professor R. H. Thurston says in the December *Forum:* "The assumption seems fair that the locomotive engine will have been superseded when we double our speeds, and that we must find ways to utilize the weights of the cars themselves for adhesion, and to make each to carry its own motor. This evidently points to electric traction, the only method as yet discovered of keeping the horse in the stable and yet of making him do his work without taxing us for his own carriage. I have very little question that, where railways are carrying large numbers of passengers on short routes, as on our elevated systems of road—where, if ever, we may reach enormously high speeds—the electric motor or some advance even on that latest marvel of invention and engineering, must come into use. Heat, light and electricity will then conspire in that coming revolution which shall combine for us the speed of the bird, the comforts of home and the safety of a hermit's cell. And what must come will come."

Motor Combined with a Fog Bell.

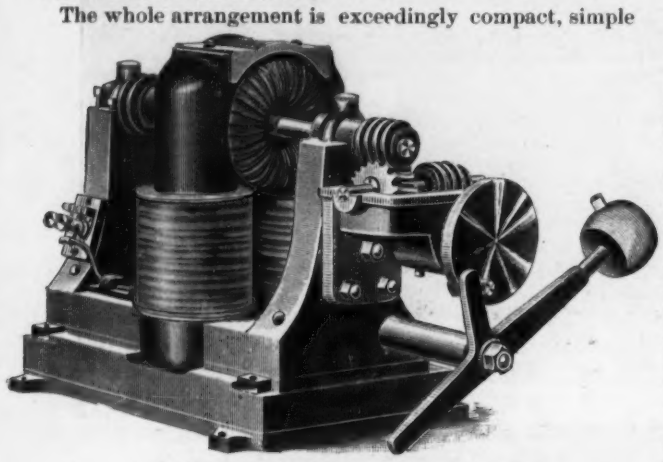
An instance illustrating the universal application of the electric motor has been lately furnished by the Thomson-Houston Electric Company. The novelty of the application and the mechanical arrangement devised to attain the desired result deserve special mention. The apparatus shown in the cut is to be used to operate a fog signal bell on one of the lighthouses of the Great Lakes.

Referring to the cut, it will be seen that a steel worm is keyed securely to the armature shaft of the motor and is

in gear with a brass pinion situated directly underneath. Upon the same spindle which carries this pinion is secured a second worm in gear with a second pinion, thus making what may perhaps be called a double worm and pinion. The cast iron face plate shown to the right of the cut is provided with a projecting lug, the plate and lug together forming a cam. This is secured to the spindle of the pinion, not shown in the cut, by a set screw.

The upper half of the cast iron box inclosing the gears is removed in order that the mechanism may be clearly seen. In practice the gearing is immersed in oil so that no attention is necessary. The speed is reduced from 2,300 revolutions per minute at the armature shaft to 12 revolutions per minute, the hammer delivering strokes on the bell at five second intervals.

The whole arrangement is exceedingly compact, simple

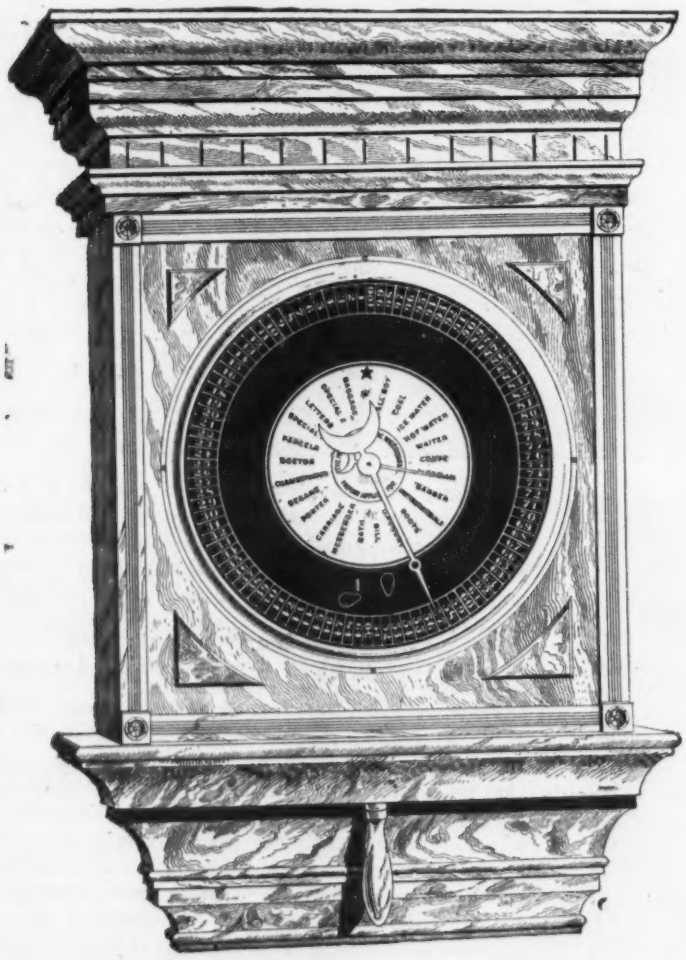


Motor for Striking a Fog Bell.

and ingenious. This arrangement of gearing will doubtless be of excellent service where a great reduction in speed in a small compass is desired.

The Porter Electric Messenger System.

The Porter electric messenger system, illustrated on this page, is intended for use in hotels, apartment houses and other places in which an improved form of annunciator is needed. Some of the advantages claimed for this system



PORTER MESSENGER CALL SYSTEM.

are that it enables the occupants of the room to telegraph their wants directly to the office, so that they are instantly understood by the clerk; it notifies the guest that the message has been received at the office; and it will convey correctly every message sent from the rooms, though one hundred guests may call at exactly the same instant. The apparatus is manufactured by the National Electrical Manufacturing Company of this city.

The apparatus in the office, as shown in the cut, is provided with a dial 20 inches in diameter, upon which appear the numbers corresponding to the rooms. The long hand or pointer, as shown, designates the room from which the message is sent; the short hand shows what is wanted. Each room is provided with a circular call box, on the dial of which is printed the names of twenty or more different articles, such as are usually required by the guests. The hand may be moved in either direction by means of a knob in the centre of the dial.

To operate the instrument, the occupant of the room first opens the hasp of the room box, turns the little hand to the required want, then closes the hasp, leaving it in this position; this sets in motion the hand on the dial in the office, which swings around until it reaches the number corresponding to the room from which the call has been sent, where it stops. At the instant the long hand stops at the room number, the short hand begins moving, stopping as soon as the want indicated by the little hand in the room box has been reached. This action carries the hand in the room back to the starting point, which is a signal to the guest that the message has been received.

The Telephone in Iceland.

Mr. Charles Sprague Smith, writing to the editor of the *Evening Post*, says: "The telephone has just been introduced between Reykjavik, the capital, and Hafnarfjörthr, a fishing village about six miles distant. The 'leader' in the *Isafold* states that the rules for the use of the telephone were discussed and decided through the instrument, one of the three directors sitting at the Hafnarfjörthr end of the wire, and the other two in the office at the capital. The telephone has thus in Iceland anticipated the telegraph. The communication of messages over a wire appeared so mysterious that some of the more adventurous spirits among the bystanders resolved to investigate. One scaled the roof of the Reykjavik office and placed his ear to the wire; a second declared that he heard the wire 'whining' for a long distance; a third brought a letter that he wished sent by wire post. The tariff is exceedingly moderate, being only seven cents (25 öre) per message. The cost of the plant was about $840."

A New Arc Lamp.

In the effort to produce an arc lamp the carbons of which would have a life sufficiently long to burn for several days, Mr. O. E. Lundstedt, of Brooklyn, has invented and constructed the lamp shown in the accompanying illustrations. As will be seen, the carbons used are circular discs, and are about three and five inches in diameter respectively, the positive one being, of course, the larger of the two. The carbons are suspended on the two electrodes of the lamp with their edges near together and the discs are in the same plane. Both carbons are revolved at a fixed rate of speed, turning round upon their axes once in perhaps 10 or 15 minutes.

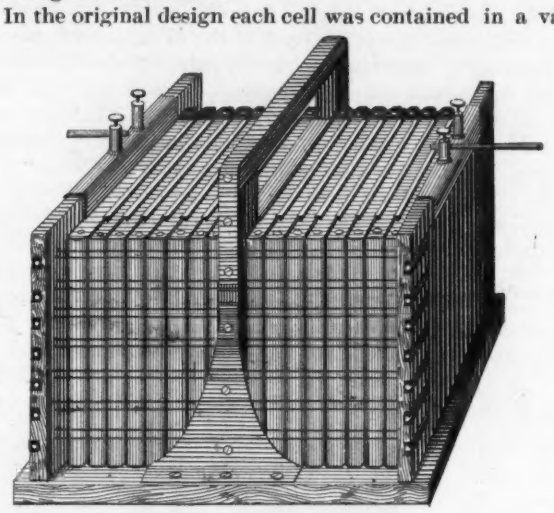
LUNDSTEDT'S ARC LAMP.

The clock work, by means of which the carbons are revolved, is placed above, as shown in the cut. The axis of one carbon is fixed while the other has a motion of translation parallel to itself through a small arc of a circle, whose radius is about six inches in length. An electromagnet placed in shunt to the lamp is alternately magnetized and demagnetized as the escapement wheel placed near it closes the circuit at regular intervals. The armature of this magnet communicates its motion to a step by step mechanism and turns the carbon discs upon their axes at a regular rate of speed. The armature of another electromagnet, whose coil is placed in series with the arc, actuates the mechanism which regulates the distance between the carbon discs. The extreme height of the lamp is much less than those in ordinary use. The first lamp constructed from Mr. Lundstedt's plans is now on exhibition at the office of the Electrical Device Company, at 42 Wall street, in this city. As will be seen from the illustration the lamp is surmounted by a suitable shade, the feeding mechanism being above the shade. Several changes are contemplated in the construction of the original lamp. The circuit upon which the lamp is intended to run is that used in ordinary incandescent lighting.

The Reynier Elastic Accumulator.

M. Emile Reynier, the inventor of this battery, has furnished to the London *Electrician* the following facts regarding his accumulator:

In the original design each cell was contained in a varnished sheet iron vessel lined with india-rubber, and was composed of two positives and one negative, separated by sheets of porous silica, the two end sheets being fluted to increase the space available for the electrolyte, the quantity of which was, however, small. In the latest type of cell M. Reynier uses containing vessels of pure lead, the necessary flexibility being obtained by surrounding the lead cell with an expansible corrugated case. A number of



Reynier's Accumulator Cell.

cells are connected in series and placed between two rigid end pieces drawn tightly together by strong springs. This arrangement gives the active material considerable artificial elasticity, which enables one to attain a high rate of discharge and to obtain a high output for a given weight. The expansions and contractions of the plates can take place freely without disintegration owing to the action of the springs. There is a difference in length of as much as six per cent. between a completely discharged and a fully charged battery. Moreover, the active material being constantly under pressure, there is no need for heavy grid-like supports. Finally, the plates and the cells being held together in this elastic manner, they are able to withstand severe shocks, and are from that point of view alone peculiarly suited to the exigencies of traction work.

The annexed figure represents a storage battery of the latest type. It consists of 16 cells mounted between end pieces of hard wood, strengthened by iron bands. The fol-

lowing are some figures with regard to this particular type of storage battery:

E. M. F. (full)	32 volts.
E. M. F. (at terminals)	28 "
Discharging current	3 to 6 ampères.
Average available energy	150 watts.
Capacity	38 ampère hours.
Work (available)	740 watt-hours.
External dimensions: length	16 inches.
External dimensions: breadth	12 "
External dimensions: height	12 "
Total space occupied (less than)	1.5 cubic feet.
Total weight	110 pounds.
Weight per watt-hour	.15 "
Watt-hours per pound of cell complete	6.73
Volume per watt-hour	3 cubic inches.

It may be added that the figures for the total weight and total volume include everything, and that the battery is very solidly constructed in view of its employment in electric tramway and similar work.

The Window Beautiful.

Electrical supply companies are fortunate in receiving varied lines of new goods that possess unusual interest to the mechanic, the engineer and the intelligent pedestrian irrespective of vocation, as well as to the professional and the amateur electrician, and which can be displayed with excellent and profitable results in properly arranged show windows.

But many houses are prone to neglect this most excellent means of advertising and thereby lose the benefit of a certain number of cash sales that would certainly come to them without further solicitation; " dropping in " sales they can be properly termed. A few houses allow an ill assortment of goods to remain in their windows for weeks at a time regardless of effect or of the accumulation of dust. A second class endeavor to keep their display clean, but consider the time spent therein as little better than lost, while a third class practically neglect all their opportunities. All are in the wrong; first, because the labor and expense incurred would be returned in the profit on increased sales, and second, because the actual outlay of cash can be reduced to a very small amount by the judicious exercise of tact and taste. For instance: You plan to have the background in your window represent a raised dais, made in the form of a double curve, with shelves rising from the front to rear; this can be made by the packer from broken shipping cases, and when placed in position may be covered with black, crimson or purple canton flannel drapery, costing 15 cents a yard. Then the larger articles can be displayed at the base, and the size decreased on approaching the top. Such a background should not cost to exceed $5, and it can be used on six or eight different occasions during the year. On another occasion the window may have a crimson ground on which are neatly piled sample coils of all the various wires carried in stock, each coil being properly labeled so that an intelligent interest may be aroused. Do not insult the passers-by through exciting their curiosity regarding the purpose for which certain articles displayed may be designed and then leave them in utter darkness, but have it plainly stated in a neatly printed card. It is not wise to place delicate or expensive instruments in show windows unless perfect protection from the rays of the sun are insured. Battery tops, annunciator and office wire, and other articles having a coating of paraffine, are liable to be injured by the direct rays of the sun. Therefore, secure a good awning at the outset. Electrical books are excellent articles to fill in a display with, and as there are many now selling from 50 cents to $1.50 each, the price should be plainly shown in order to induce the looker-in to purchase a copy, for that is the main object of dressing your windows; simply to secure the loose sheckles burning in the stranger's pocket. Strange as it may appear, a supply house can always sell a far greater number of electrical books than the leading booksellers can if they will only display the same.

"It is a matter of some surprise that supply companies do not lead in the matter of original displays that can afterward be turned to profitable advantage," said the manager of a prominent Chicago dry goods house. And it is a well known fact that progressive dry goods and clothing merchants often turn to the electrical companies for a window attraction. One prominent house often rents various forms of apparatus for a period, never exceeding a week, but paying liberally for the same. During one week a small motor operated some simple mechanical device; again, a 10-light incandescent dynamo belted to a concealed motor was set up in the window and the lamps strung on regular circuits with wires suspended from miniature poles and cross arms. In each case large crowds were attracted and the display proved an instructive object lesson as well as a profitable card, for while the attention of the passer was caught by the one novel feature, yet a large number of robes and other articles of drapery dear to the feminine heart (as well as to the purse of the male wage earner) were so tastefully arranged that all blended and harmonized in one perfect picture that enticed many a buyer within the doors of that mart of merchandise. Then there was a windmill operated by an electric motor. But there are many small articles that can be successfully utilized for decorative purposes, as, for instance, the vacuum tubes of Geissler when rotated within a covered and darkened space, having an entrance shaped similar to the mouth of a cavern, and closely surrounded with dark robes surmounted with articles of lighter hue. The necessary current for both rotator and Rhumkorff coil could be obtained from a storage battery, care being taken to place the cells where no ill effects will result should any fumes be given off by the acidulated fluid used. Then there is the beautiful effect secured by entwining small incandescent colored glass bulbs with flowers and vines and ferns, the colors being arranged to harmonize with the shades in the goods exhibited. Possibly it would prove a paying enterprise if some bright individual gifted with excellent taste and original ideas were to start in business as an electrical decorator, giving his services not only to the larger houses, but also to wealthy families desiring to introduce novel features in decorative effects at receptions, balls, etc.

Less than a thousand dollars would purchase all the needed supplies, including a sufficient number of small storage cells, and many things required could be borrowed or paid for in a judiciously worded card attached to the display, or in the report of the affair given in the daily paper as current news. And then photographic views of special displays might be sold or a cut of same secured for some journal, though the writer does not know of a paper devoted solely to the interests of the window dresser. Surely such a publication ought to pay well, if well edited.

Fire at Grosvenor Gallery Central Station.

The following is Mr. Ferranti's statement of the facts relating to the fire at the Grosvenor Gallery central station, a notice of which appeared in our cable dispatch in THE ELECTRICAL WORLD of Nov. 29: "Up till recently, the Grosvenor Station was supplying the whole of the lights of the London Electric Supply Corporation. Due to the obtaining of an injunction by the neighbors the corporation has been obliged to abandon this station for generating purposes and use it only for a distributing station. It was necessary, so far as possible, to stop down the Grosvenor generating station, turn out a certain portion of the machinery which had been running there and install the necessary converting machinery for the purpose of transforming from the high tension to the intermediate tension for supplying to the customers. All this had to be done with the minimum of delay. It was, therefore, a case of stopping down on Saturday nights and working as hard as possible to finish the installation of the transformer machinery by as early an hour on Sunday afternoons as possible. This process was partly done. The whole of the work which was put in was of an entirely temporary nature, india-rubber covered wires being used for carrying the current, light woodwork being used to support these wires, and the switches instead of being upon permanent supports were held by woodwork.

"The accident occurred at 6:30 on Saturday morning, owing to the action of a lineman in plugging on a fresh set of converters. The man was not sufficiently cool for this particular purpose. Hesitating in putting on the switch, it arced slightly; instead of pushing it in, he drew it back and broke the contact. The heated surfaces, together with the 5,000 volts pressure which was being used, caused the arc to maintain. It ran up the woodwork and set fire to the ceiling, which was composed of crossboards with tar between for the purpose of keeping out moisture from the tank which formed the roof. The whole place was burned down in the brief space of 20 minutes. An hour after the accident occurred the whole place was quiet and fairly cool. The lineman had ample opportunity of entirely stopping any damage from his first carelessness, because the switch which he put on was only a plug, and meant for connecting a circuit, there being a large switch within a yard's distance for breaking the supply passing through the plug switches. If he had been too frightened to turn off the switch, he had again another safeguard in the safety switch at the end of the room, which would cut off the whole supply from Deptford. He also had the option of signaling to Deptford to stop the supply, but this was stopped before the man could have finished signaling, as they saw by the action of the ammeters and voltmeters at Deptford that something was wrong in London."

The value of the destroyed apparatus is said to amount to between $75,000 and $100,000 with no insurance.

Decision in a Patent Infringement Case.

In the case of Leroy B. Firman and the Western Electric Company vs. the New Haven Clock Company, the following decision has just been rendered in the Circuit Court of the United States for the District of Connecticut by Judge Shipman:

"This is a bill in equity to prevent the alleged infringement of the fifth claim of letters patent, No. 192,644, dated July 3, 1877, granted to Leroy R. Firman, for improvements in automatic signaling apparatus, used in the system known as the 'district telegraph system' in which each station is designated by a number, and the apparatus is constructed to write that number as a 'call' and subsequently to write any one of several signals, at the will of the operator.

"The apparatus was an improvement upon the device described in letters patent No. 185,455 to G. S. Ladd and S. D. Field, which contained one circuit-breaking wheel, described by one of the experts for the plaintiff, as follows: 'Having a certain set of teeth or notches upon its rim extending partly around, so as to give a station number or call, the remaining portion of the rim being divided into teeth placed at regular intervals apart, so that they will causes a series of equal spaced dots upon the paper of the register at the receiving station, amounting altogether to one more than the number of special signals provided for.'

"A movable plate, with enough to cover two teeth, is placed against one side of the wheel, and thus a dash is formed, instead of two dots, when these teeth pass the contact point. Any two adjacent teeth may thus be combined, and the special signal depends upon where the dash is formed. The operator determines the special signal by observing which two dots are united to form a dash.

"The patentee divided this signal wheel into two wheels. Upon part of the rim of one wheel there were the unequally spaced notches which designated the call, the remaining portion of the rim being without teeth and connected with a segment of a cog wheel, and upon part of the rim of the other wheel were equally spaced notches which designated the special signal. The second wheel is brought into action after the call which has finished its work. It is connected with another segment of a cog wheel, the teeth of which are capable of being moved into position, in which they will be engaged by the teeth of the segment of the first wheel. After the call has been given the teeth of the segment of the call wheel are brought into position to engage the teeth of the segment of the signal wheel. This description of the Firman wheel is abbreviated from a longer description given by Mr. Quimby, one of the defendant's experts.

"Two signaling wheels are described in letters patent to E. A. Calahan, 129,526, and to T. A. Edison, No. 146,812, each issued before the date of the Firman patent, for sending, when successively operated by successive and distinct acts of the operator, different signals by prescribed different systems of breaks of the circuit, but not for sending automatically these different signals. It does not appear that either of these inventions went into actual use.

"The improvement consisted in two wheels, instead of one, which automatically and successively communicated to the central office the two sets of signals. It is thus described in detail in the first claim:

"'1. The signal mechanism, operated by suitable clock work, provided with a writing wheel constructed to give the call or number of the station, and another adjustable wheel, which stands still while the call is being written, and is engaged by the mechanism after call has been sent, and is caused to turn through whatever space or number of teeth desired, by setting the pointer substantially as specified.'

"The fifth claim and the one which is said to have been infringed is as follows:

"'5. The combination, with a call-writing wheel, of a signal-writing wheel, moved by the same power, when the latter is provided with a number of equal-spaced teeth, which write the signal desired by making a certain number of equal spaced impulses substantially as specified.'

"The defendant uses an apparatus which is described in letters patent No. 321,073, dated June 30, 1885, to Frank B. Wood. It produces a compound signal by the joint action of two wheels. It has 'two signal wheels which are geared to each other and to the clock work, so that they both move simultaneously and in unison during the time that both parts of the compound signal are being transmitted; while thus in motion, they are acted upon by opposite ends of the same electrical contact spring.' The smaller wheel runs continuously; has a series of equally-spaced notches, and tends to transmit a recurring series of breaks at equal distances apart. The larger wheel has certain portions of the periphery cut away. When both of these wheels are moved simultaneously in the same direction, the small wheel sends a continuous series of signals, but those which are not needed are cancelled and prevented from being sent by the action of the larger wheel with its spaces of cut-away periphery, and thus the final result is to give first, the signal and then the call. The result is, substantially, that of the Firman device.

"The plaintiffs claim that the equivalent of the Firman signal wheel is the small wheel of the defendant, which transmits a series of equally spaced impulses and that the equivalent of the call wheel is the large wheel of the defendant, which has its periphery so cut away as to determine the numerical signal which is sent, notwithstanding that the actual transmission of the signal is performed by the other wheel, and that thus the defendant's device contains the call wheel and the signal wheel of the fifth claim.

"If a literal construction is to be given to the fifth claim, and the requisites of infringement are a signal writing wheel, with equally spaced teeth, which makes equally spaced impulses, and a call writing wheel in combination, regardless of the manner in which these two wheels operate to produce the result, the remaining element being power operating the two wheels in such manner as to transmit the compound signal at one operation, then the defendant infringes.

"In my opinion such a broad construction cannot be given, but the scope of the patent must be confined to mechanism substantially such as is described in the patent, viz., two wheels, moving by the same power, in succession and automatically, one of which produces a part of the signal by its sole action, and the other of which produces the other part by its sole action. It is true that the Firman invention was the first one having two wheels which did both parts of the work automatically, but this step cannot give the device the character of a primary invention and permit the inventor to include within his patent wheels, which differ so widely from his apparatus as do the double wheels of the Wood patent.

"This seems manifest from the place which the invention occupied in the history of the art. Two wheels, acting in succession, but operated by separate acts of the user, had been known, and a single wheel, which made in succession the two sets of impulses, preceded Firman, whose advance was to make the single wheel into two wheels, one having equally and the other having unequally spaced notches and to move them by the same power, so that two signals should be transmitted successively by one operation; but this step did not entitle him to include in his patent two wheels which so act with each other and produce a compound signal, one wheel actually producing the impulses and the larger wheel determining which of the impulses shall go through the line and be recorded. These wheels cannot, in view of the limited character of the Firman invention, be properly styled the equivalents of the call-writing wheel and the signal-writing wheel of the patent, although they produce the same result.

"The bill is dismissed."

George P. Barton and Wm. Edgar Simonds argued the case for the plaintiffs, and Harry M. Turk and Arthur V. Briesen for the defendant.

The Electrical Stock Market.

The panic, it appears, has at last lost its hold. Matters at the end of the week present a much better appearance than for some time past. The reaction which occurred several weeks ago was a little too quick to be accepted by conservative purchasers. Now the condition has changed and apparently the light has at last dawned for a healthy reaction. Money on call is easy; the banks are increasing their accommodations, and with the large shipments of gold received from London the other day the indication for a rise in stocks is very good. The favorable bank statement which was issued on Saturday, showing a gain of $3,000,000 in lawful money, is satisfactory, and shows that some of the money which had been hoarded, owing to the financial scare, has returned to the banks.

The market opened very weak on Monday, and was, in fact, lifeless until Friday, when a decided improvement was shown. On Saturday the bears did their best to force prices down by throwing undue importance on the failure of a London dealer in American securities, but were successful for a short time only, and the market closed much firmer and steadier than several weeks past.

The reports from London indicate that the money market there is in a much better condition than at any time since the panic. After the smoke has cleared away it will be found that London will be a larger purchaser of American securities than ever. The English investments in Africa and the Argentine Republic have proven that securities must be more available for ready cash, and, while American securities may fluctuate, money is readily obtainable upon them at any time. The demand from England for industrial and manufacturing businesses has therefore been increased by the past financial difficulties, and next year will see more enterprises successfully floated in London based upon American business than ever before. Any first-class business showing a net profit of 12½ to 15 per cent. for three years on the price asked is salable in London. The preference, however, is for monopolies in the manufacturing line and breweries. The usual way is to pay two-thirds cash and the remainder in six per cent. bonds or shares.

Electrical stocks during the past week have risen more rapidly in proportion than the general stock market. Upon the basis, therefore, that the worst is over we find that these stocks have not fallen so low as those of the general market and have risen to normal more rapidly. This is certainly an argument in favor of electrical stocks.

Notwithstanding the fact that everything looked rather blue last week, the desirability of investment at the figures quoted on Bell Telephone stock was expressed to our readers in the last report. Those who heeded this advice and bought at 200 in the early part of the week were able to sell on Saturday at 210, representing a clear gain of $10 a share. There is a great hue and cry at the present time about the unlimited coinage of silver, and many persons think it is the balm for all financial ills.

If people could be prevented from going into debt, then the unlimited coinage of silver would be a success, and there could be no excess of values. It must be taken for granted, however, that business will continue upon the same basis as heretofore, and commercial paper will be used in the transaction of a larger part of the world's trade. When commercial paper is set afloat we have excess of values; therefore the remedy is not so much in the vast volume of silver afloat, but in the character of commercial paper and securities representing value. The nearer they come to representing what they pretend to, and what is written on their face, the better, as no amount of coinage, unlimited or otherwise, can make a protested note worth a dollar.

The less legislation that takes place upon financial questions at present the better. The constant agitation of the tariff by Congress has done a great deal toward frightening people into hoarding their savings, and if the Secretary of the Treasury and Congress are to be appealed to for money every time there is an overissue of commercial paper in this country, there must be something wrong with our financial institutions. Money is easy, as we have already stated, and the banks lend money on good security. Why not, therefore, now that things are commencing to show up brighter and the savings of the people are beginning to be placed in the banks again, leave business to run on an even keel for a while at least until such summary action is necessary as is proposed by politicians. There are bound to be business failures, and many of them at this time of year, because it is the period of settlement. Such is the record of past years, and this one is not likely to prove an exception.

A number of electrical companies have given notice of paying dividends during the past week. Commercial cable stock receives its sixth dividend of 1¼ per cent. upon the outstanding stock of the company. This dividend will be paid Jan. 2.

The board of directors of the Western Union Telegraph Company declared the eighty-ninth dividend on its stock, being 1¼ per cent. on the capital stock, net earnings of the three months ending Dec. 31.

The Edison Illuminating Company, of New York, has declared its twenty-third quarterly dividend of one per cent. In addition thereto the directors have declared a dividend of five per cent. on the capital stock, payable in certificates convertible into stock at par whenever the company shall increase its capital stock beyond the present authorized amount or redeemable in cash at par at the option of the company. Until so converted or redeemed the certificates will bear interest at the same rate and payable at the same time as dividends may be paid on the company's capital stocks.

The cable stocks have been steady all the week and not at all affected by the condition of the market. Western Union stock has risen 1¼ points, and gives very good evidence of continuing on its upward course.

Edison stock has had a good market and made a splendid rise during the week from 70 to 87, a net gain of 17 points. Few, if any, stocks on the New York Stock Exchange have done as well. It looks as though the end of next week would see the stock still higher.

Thomson-Houston stock has remained very steady and closes one-half point higher than last Saturday.

Most of the telephone stocks show a rise; particularly American Bell, closing at 210. This stock is likely to go higher yet before any great length of time.

The special meeting of Westinghouse stockholders, which took place during the week, ratified the proposed action of issuing the entire $10,000,000 of capital stock, $3,000,000 of which is to be "preferred." Before the meeting stock sold at 13, and after it had taken place the stock went up to 13½ and has been selling around that figure the balance of the week. At the closing hour on Friday a large sale brought the stock down to 12¾. All things considered, the stock has done well.

North American Phonograph Company stock, and in fact most of the local phonograph stocks, have been somewhat inactive of late. There is no good reason for this. North American stock has already paid three dividends, and it represents not only a large interest in the receipts of the phonograph proper for business purposes, but also receives an interest in the phonograph doll and the nickel-dropping automatic phonograph as well. These automatic machines are to be found everywhere and are very popular. The phonograph for business purposes is also increasing in popularity and usefulness.

It is stated that a new and more scientific phonograph is to emanate from the Edison laboratory the first of the year. This machine will make possible the use of the small mailing cylinders and will certainly facilitate social correspondence. Phonograph stocks at the figure they are offered at present ought to be considered cheap, and there is little prospect after they have once recovered from the position they are now in that they can be had for the price at which they are now selling.

Phonograph doll stock has been lifeless in Boston for a long time. This company has been reorganized recently, and it is understood that Mr. Edison has obtained control. An improved phonograph for the doll is now ready and is much more satisfactory, talking louder and more distinctly than the other one.

The closing quotations of electric stocks, from F. Z. Maguire & Co., Electrical Securities, 18 Wall street, N. Y., on Saturday, Dec. 13, 1890, on the New York, Boston and Washington stock exchanges and Pittsburgh closing Dec. 12, were as follows:

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
NEW YORK.				
Western Union Telegraph Co	100	86,200,000	75⅞	76⅛
American Telegraph & Cable	100	14,000,000	83	85
Central and South American	100	5,000,000	150	160
Mexican	100	2,000,000	210	215
Commercial Cable Co	100	7,716,000	101	103¼
Postal Telegraph Cable	100	5,000,000	39	41
Edison General Electric Co	100	9,503,500	87	90
" Deferred	100	2,496,500	....	....
Consolidated Electric Light	100	1,922 400	....	....
Edison Electric Illuminating Co	100	2,567,800	70	....
United States Electric Light	100	1,500,000	30	....
North American Phonograph	100	6,200,000	30	....
BOSTON.				
Thomson-Houston Electric Co	25	6,000,000	29½	40
" " preferred	25	4,000,000	25½	25¾
" " Series C	10	400,000	...	12
" " Series D	10	120,000	5¾	....
" International Co	100	350,000	....	....
Thomson Welding Co	100	1 000,000	....	200
" European Welding Co	100	1,500,000	....	50
Ft. Wayne Electric Co	25	4,000,000	10½	11
Telephone:				
American Bell	100	12.500,000	210	212
Erie	100	4,800,000	46	47
New England	100	10,304,600	49	50
Mexican	10	1,280,000	70c.	80c.
Tropical American	10	400,000	....	1¼
MISCELLANEOUS				
Edison Phonograph Doll	10	1,000,000	....	2
WASHINGTON.				
Pennsylvania Telephone	50	750,000	25	32½
Chesapeake & Potomac	100	2,650,000	68	70
American Graphophone	10	600,000	10¾	11⅛
United States Electric Light (Washington)	100	300,000	..	140
Eckington and Soldiers' Home Electric Ry	50	352,000	53	55
Georgetown and Tennallytown	50	200,000	46	55
PITTSBURGH.				
Westinghouse Electric Mfg. Co	50	5,000,000	12¾	13⅛

Col. S. G. Lynch, broker, of 153 Monroe street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$298@$300	Cumberland	$ 59@ $60
Central Union	57@ 58	Wisconsin	118@ 120
Michigan	91@ 93	Bell of Missouri	155@ 160
Great Southern	32@ 35	Iowa Union	20@ 21
Colorado	38@ 40	Missouri and Kansas	55@ 57
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$85@$90	Chicago Edison Co	$128@$130

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Dec. 15, 1890.

The list of awards, at the fifty-ninth annual exhibition of the American Institute, to electrical companies is as follows: Clark Electric Company, automatic safety device, special; Schuyler Electric Company, electric light dynamo, etc., superiority; Mather Electric Company, electric dynamos, etc., superiority; Clark Electric Company, electric arc lamp, superiority; Metropolitan Electric Signal Company, signal apparatus, superiority; Crosby Electric Company, electric goods, etc., superiority; Himmer & Anderson, dry battery cells, excellence; James H. Mason, primary battery, etc., merit; Andrew H. Brown, electric leak detector, etc., merit; Munsie & Coles, electrical conduits, etc., merit.

A permanent electrical and mechanical exhibition is under discussion by some of our electrical people. This is a very much needed enterprise in this section. Already capital has been subscribed, and it is desirable for the success of this undertaking that all the leading enterprises should become interested to some extent. Mr. F. Lesher, who has introduced an exhibition in Brooklyn, which is meeting with good success, is at the head of this new enterprise. The object of this exhibition is to introduce to possible buyers every electrical article that is now distributed throughout this city and the country generally among the supply houses, and to have all exhibits in practical operation for the education and convenience of buyers, as it would save them time and labor, as well as bring to their attention many articles that are now practically unknown and inconvenient to be seen.

Address Before the Electric Club.—The regular monthly meeting of the New York Electric Club will be held Thursday evening, December 18. Prof. Francis B. Crocker, of Columbia College, will lecture on "Electrical Units of the Present and Future." Prof. Crocker will review the derivation of, and relations between, the present electrical units, and discuss the creation of other electrical units which now are, or soon will be, required in electrical science and industry. It is proposed to treat this subject, as far as possible, in a non-mathematical manner, and give the most important facts regarding electrical units in popular yet comprehensive language. A brief business meeting of the club will be held at 8 o'clock to discuss proposed amendments to the by-laws. The lecture will begin promptly at 8:30. This is the last meeting of the present year. The club's regular dinner (costing $1.00) will be served from 6 to 8 P. M. Members who expect to dine at the club should notify the clerk at the club house. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, Dec. 13, 1890.

The Standard Electric Supply Company has been appointed New England agent of John A. Roebling's Sons Company, of Trenton, N. J.

The Globe Belting Company, of Boston, has just finished a 36-inch double belt 104 feet in length, weighing 570 pounds, for the Lynn belt line street railway.

The Pettingell Andrews Company has been appointed Eastern agent for the celebrated Paiste switch and other specialties manufactured by H. T. Paiste.

Saccarappa, Me.—The Saccarappa Electric Light Company is putting in four 500-volt Mather generators to furnish power for the Cumberland mills, situated about a mile away.

Lisbon, N. H.—The Edison General Electric Company, through its Boston branch office, is installing an 800-light incandescent plant at this point for the Lisbon Edison Electric Company.

The Bird and Sloane Construction Company is agent for J. W. Colburn & Co.'s new model direct current dynamos, both arc and incandescent. Increasing sales are reported.

The Newburyport and Amesbury Street Railway Company has just purchased of J. A. Grant & Co. 400 h. p. of McIntosh and Seymour compound condensing engines.

The Eastern Electric Cable Company, manufacturer of the celebrated Clark wire, has declared its regular semi annual dividend of three per cent. on its preferred stock, payable Dec. 16.

Brunswick, Me.—The local electric lighting company is replacing its present storage battery plant with an alternator of the National Electric Manufacturing Company's type to be run by water power.

The Lebanon (N. H.) Building and Power Company has purchased a 500-light dynamo of the Standard Electric Company, of Vermont. Mr. Ferrin, of this company, captured several large orders on his last trip.

Belfast, Me.—The new power station at this point is situated across the river from the town, where water power can be taken easily. The power wires run under water next to the drawbridge. Clark's cable, guaranteed for five years, is used.

W. S. Hill, of Boston, shipped last week 50 of his well-known switches and converter boxes to California, another large consignment to Portland, Ore., one to Texas, and several to other States. It is only necessary to have the merit of these goods known to sell them.

Bangor, Me.—The switchboard of the new electric light station is 20 feet long and composed entirely of slate; into this run the main feed wires from the power plant at Veasie, and from it run distributing wires to all parts of the city. The board is an elaborate affair, and a great credit to the station.

Will Move to Larger Offices.—The New England Department of the Edison General Electric Company is so crowded with business, the sale of dynamos and motors being especially large, that new accommodations are a necessity, and they will shortly move to large and elegant offices now being fitted up on Arch street, where Messrs. Payne & Francis say "the latch string will always be out."

Electric Light Plant for India.—F. M. Kimball & Co. shipped this week a 15-light self regulating dynamo with spare armature and duplicate parts to be used in a Rajah's palace in farther India. A two-horse Shipman engine goes with it. They also shipped this week 25 and 35-light machines to the City of Mexico. Messrs. Kimball & Co. will remove their present offices from 149 Portland to their old office at 103 Merrimac street until additions to their factory are completed, when they will remove to 160 Portland street. The proposed addition will be about 3,000 square feet of floor space, and enable them to have room for their rapidly increasing business. L. H. H.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 CITY BUILDING, PHILADELPHIA, Dec. 13, 1890.

Mr. H. T. Paiste is working hard to keep pace with the great demand his goods are receiving. He has just imported a large supply of china switches decorated in many colors in imitation of wall paper and different kinds of wood and house trimmings.

The Spellier Electric Time Company held its annual meeting last week and elected Mr. Henry Van Bell president and Mr. Henry B. Cutter secretary, treasurer and general manager. The treasurer's report showed the company to be in a prosperous condition.

Messrs. Wright & Starr have been working for some time on the plant of Mr. James A. Wright, in Germantown, which we mentioned some time ago. The battery seems to be in better condition than it was at first thought to be. They expect to put the plant in first class class condition.

Mr. C. M. Blanchard has sold to the Lock Haven (Pa.) Electric Company a 1,250-light alternating self-exciting dynamo, a 125 h. p. Corliss engine, a 280 h. p. return tubular boiler and has contracted to do four miles of pole construction and all the inside wiring for a 1,200 incandescent light plant.

Mr. J. W. Parker, of this city sold to the Port Deposit Electric Light Company, at Port Deposit, Md., a 100 h. p. Ball engine and boiler and has contracted to do all the construction work for a 900-light Edison incandescent plant; also sold a 150 h. p. compound Ball engine to the Rock Creek Railroad Company, of Washington, D. C., during the past week.

The alternating arc plant installed by W. R. Muckle, Jr. & Co., for the Reading Railroad at Port Richmond coal wharves some eight months ago has given great satisfaction, and the railroad company has increased the capacity of the plant by adding 10 more arc lamps. Messrs. Muckle & Co. have sold Mr. W. F. Parker, of Nineteenth and Market streets, this city, an incandescent light plant of 75 16 c. p. lamps.

The Duplex Electric Company, Limited, of Corry, Pa., has been duly organized, and the following officers have been elected: President, Henry Kepple, of Torpedo, Warren Co., Pa.; treasurer, Dr. Charles B. Kibbler, of Corry, Pa.; secretary, Charles J. Swift, of Corry; electrical engineer, Wm. E. Cady, of Corry; mechanical engineer, Albert Gisel, of Corry. The company will make a specialty of manufacturing and dealing in the electrical devices patented by Mr. Wm. E. Cady, and will do a general electrical busi-

ness in arc and incandescent lighting apparatus, electrical instruments, measuring and testing apparatus. A number of the Cady devices have been in use for some time and have given perfect satisfaction, and the outlook of the new company is very promising.

Mr. H. B. Cutter, of this city, has just finished installing a system of incandescent lighting at the new People's Theatre at Kensington. The system is so arranged that the footlights and border lights are regulated independently by switches at the gas box, the lights in the auditorium being regulated by one switch, sections of which can be turned off or on by division switches. This plant is supplied with current by an alternating dynamo. The regulating boxes are resistance coils instead of the choke coils that are usually used on the alternating systems.

Walker & Kepler have just finished installing the following Edison incandescent electric light plants: An additional 500-light dynamo at the Franklin Sugar Refinery, giving a total capacity of this plant 4,500 lights, making this one of the largest isolated electric light plants in the country; C. K. Masland & Sons, Amber street and Allegheny avenue, carpet mills, one 90-light machine; Hance Bros. & White, chemists, Marshall and Callowhill streets, one 270-light machine; Alfred Oliver, Lehigh avenue and Mutter street, stockinet mill, one 135-light dynamo. W. F. H.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Dec. 13, 1890.

Milwaukee, Wis.—It is currently reported that a consolidation of the Villard and Badger interests in Milwaukee will shortly take place.

Mr. Willard, the well-known representative of the Interior Conduit and Insulation Company, has been a welcome visitor in Chicago this week.

The Pumpelly Storage Battery and Electric Motor Company will remove its factory and office to the Springer Building, 203 South Canal street, Chicago, on or about Jan. 1.

Mr. E. P. Morris, lately of the Novelty Electric Company, of Cincinnati, has identified himself with the Thomson-Houston Company as traveling salesman in the railway supply department.

Electric Welding.—The manufacturing firm of Craver, Steele & Austin, located at Harvey, a suburb of Chicago, are about to introduce the process of electric welding into their works at that point.

The many friends of J. R. Gordon, Texas agent for the Westinghouse Electric and Manufacturing Company, will be pleased to learn that after two months severe illness he is once more on the road as bright as ever.

Mr. J. P. Reynolds will hereafter represent the Great Western Electric Supply Company as traveling salesman. Mr. Reynolds was at one time connected with the Novelty Electric Supply Company, of Cincinnati, O.

E. D. Stiff, 67 South Canal street, Chicago, is installing a novel and unique system of elevator call, using the ordinary annunciator and push buttons, but dispensing with the usual cable. The cost of installation is said to be very low.

The St. Louis Electrical Supply Company has closed contracts for the installation of complete lighting plants in the new Branch Brewery, and in the factories and warehouses of the Ligge & Meyer Tobacco Company, of St. Louis.

Mr. George T. Hewes has lately been appointed superintendent of the Gogebic Electric Company. With the management of the company in the hands of Messrs. A. L. Dickerman and Geo. T. Hewes, its growth and prosperity are assured.

Mr. Chas. G. Armstrong has severed his connection with the Great Western Electric Supply Company, and will henceforth devote his time to the care, development and installation of his many patented devices. His present address is 333 The Rookery, Chicago.

Mr. C. H. Decker, of Detroit, Mich., has recently purchased the stock, fixtures and good will of the Detroit Electrical Manufacturing Company, and will carry on the business of that company. Mr. Decker spent a day in Chicago recently renewing old acquaintances.

Mr. M. M. Wood, district engineer for the Edison Genera Electric Company, Portland, Ore., has become associated with the Electrical Supply Company, of Chicago, in its engineering department. Mr. Wood's long experience in both electric lighting and railway work will render him a valuable acquisition to the Electrical Supply Company.

Mr. H. R. Hixon, formerly assistant manager of the Great Western Electric Supply Company, has returned from an extended trip through the eastern cities and has associated himself with Mr. George Cutter in his new enterprise. These gentlemen have several new specialties at present in the patent office, which they propose to introduce to the purchasing public very shortly.

Chicago Electric Club.—At a recent meeting the secretary was instructed to inform members that the increase in entrance fee and dues will not take effect until Jan. 1, 1891. All applications for membership therefore received in time for posting on or before Dec. 31, 1890, should be accompanied, for resident membership, by $26 only, and for non-resident membership, by $4 only, as heretofore. It is suggested that members having friends who desire to join the club in the near future should call their attention to the fact that by making application during the present month they can take advantage of the resolution above cited.

The Underwood Manufacturing Company, of Chicago, is to be congratulated upon the number of large orders which it has lately received for its popular cotton leather belting. Among the recent orders may be noted: 400 feet, 60-inch double for the Chicago City Railway Company; Davenport & Rock Island Electric Railway Company, seven 15-inch double dynamo belts; Keokuk Electric Street Railway Company, two 18-inch double and two 15-inch double; Butte City Electric Light Company, Butte City, Mont., two 16-inch double, one 14-inch double, and six 12-inch double all being dynamo belts. Contracts have been closed for several large belts, among them being one 66-inch and one 51-inch for the Springfield (Mass.) Electric Light Company, one 30-inch for the Washburn & Moen Manufacturing Company, and one 48 inch for the Rock Manufacturing Company, of Rockville, Conn.

CINCINNATI, Dec. 13, 1890.

Telephone Decision Affirmed.—The Superior Court of Cincinnati passed on the celebrated contest between the Mt. Auburn Inclined Plane Company and the City and Suburban Telephone Company. The hearing before Solicitor-General Taft last summer resulted in the granting of an injunction restraining the company from operating the Main street electric road by a single trolley system, as the escape of electricity through the ground interfered with the use of the telephone wires. This decision affirms that of the lower court, Judge Hunt dissenting. The contest was a long and memorable one, miniature street railways and telephones being operated in court. This is the road that has just been granted the right of way to extend its lines four or five miles beyond the Zoological Garden and Carthage. H. C. E.

SOUTHERN NOTES.

NORFOLK, Va., Dec. 13, 1890.

Richmond, Va.—This city now has 67 electric cars on its electric lines.

Cooper, Tex.—A telephone wire is being erected to Sulphur Springs, a distance of several miles.

Point Pleasant, W. Va.—D. S. Snyder is interested in the establishment of an electric light plant.

Mexia, Tex.—The city council is obtaining estimates for the establishment of an electric light plant.

Richmond, Va.—The annual meeting of the Gray National Telautograph Company will be held on Dec. 10.

Newport, Tenn.—The Newport Electric Light and Power Company is being organized to establish an electric light plant.

Morgantown, N. C.—An electric light plant will be put into the cotton mill of the Denavant Cotton Manufacturing Company.

Big Island, Va.—An electric light plant will be installed in the pulp and paper mill of the Lynchburg Pulp and Paper Company.

San Antonio, Texas.—Additional machinery is being added to the power house of the San Antonio Steel Railway Company.

Sheffield, Ala.—The dummy line owned and operated by the Sheffield Street Railway Company is to be changed into an electric road.

Charleston, W. Va.—The Charleston Construction Company has been incorporated for the purpose of establishing electric light plants.

Fort Worth, Texas.—New machinery will be added to the electric light plant of the Fort Worth Electric Light and Power Company.

Terrell, Tex.—The electric light plant of the Terrell Electric Light Company has been completed, and has recently been put into operation.

Nashville, Tenn.—The Front street station of the Capital Electric Company is to be enlarged, and the company's entire plant will be improved.

Harrisonburg, Va.—An electric light plant will be established by the Richmond and Harrisonburg Land Company; they desire estimates.

Victoria, Texas.—The light plant of the Victoria Light, Power and Ice Company will be increased in its capacity by the addition of more machinery.

Berkeley, Va.—The city council is negotiating with the Thomson-Houston Electric Light Company for the establishment of an electric light plant.

Nashville, Tenn.—An electric light plant will be put into the machine shops recently erected by the Nashville, Chattanooga & St. Louis Railroad Company.

Atlanta, Ga.—A charter has been applied for for an electrical road by the Capital Railway Company. Frank Carter and others are the incorporators. The road will be six miles in length.

Pine Bluff, Ark.—J. C. Calhoun and other New York capitalists are negotiating for the purchase of the lines of the Citizens' Street Railway Company and that of Wiley Jones, with the intention of changing them into electric roads.

Charlottesville, Va.—The Charlottesville and University Electric Light and Gas Company are putting in an arc light plant, to be operated in connection with their already successful incandescent plant. It is expected that the new system will be completed early this month.

Darlington, S. C.—The Darlington Light, Water and Power Company has been incorporated by C. B. Edwards and W. F. Dargan, of Darlington, and L. M. Cox, of Washington, D. C. An electric light plant will be established. The capital stock of the company is $25,000.

WASHINGTON, D. C., Dec. 13, 1890.

Change of Base.—It is stated that Mr. Samuel Norment, late president of the United States Electric Lighting Company; Mr. M. G. Emery, late vice-president, and C. F. Norment, secretary, have sold their holdings in that company, and will, with others, be interested in the new company under the Westinghouse system.

Wires under Rivers.—One day this week, Representative Lodge introduced a bill in the House authorizing the Secretary of War to grant permission to any electric, steam, oil or gas company to lay its pipes and conduits under any navigable rivers or streams in the United States, provided they do not interfere with the navigation of the waters.

The Pan Electric Case Ended.—In compliance with the decision of the Court in General Term in the Pan Electric case of J. Harris Rogers, agent, vs. A. H. Garland, et al., a reassignment of 14 patents, dated from 1878 to 1887, by General J. E. Johnston, Governor I. G. Harris and others to M. Rogers, was filed a few days ago in the clerk's office, and the Court in General Term signed the final decree, ending the same.

Dry Goods and Electricity.—The new annex of Woodward & Lothrop, retail dry goods dealers of this city, has been completed and is now lighted up by an electric light plant of sufficient size to illuminate many a small town. The Mather system is employed, there being three dynamos, two with a capacity of 650 lights and one with a capacity for 350 lights. This plant is located in the basement of the building, where there is enough machinery to run an ordinary factory. There are four return tubular boilers—two of 90 h. p., two of 60 h. p.—which heat the building, run the elevators and the engines for electric light. There is one 100 h. p. Frick-Corliss engine, a 30 h. p. high-speed engine, and one 10 h. p. slide-valve engine. Still another smaller engine is in use to afford the motive power for the Martin cash-carrier system, that has 20 stations.

Can't Tear up the Streets.—The Washington Electric Lighting Company some weeks ago applied to the commissioners of the District of Columbia for authority and permission to place and maintain its electric wires underground in and along the streets of the city, as set forth in a map accompanying the request. The commissioners at the time referred the matter to the attorney for the District, with the request that he furnish an opinion as to the powers held by the commissioners in the premises. The attorney submitted an opinion in which he held that the commissioners might legally grant the permission desired. Mr. Thomas, assistant attorney for the District, who made the report, has submitted a second one. He goes into the law of the case at length, and says in conclusion: "From the best reading I have been able to give the statutes on this subject, I think the language employed in the act of March 2, 1889, authorizing the overhead wires of any telegraph, telephone or electric light company to be laid under ground, must be construed as though it read: 'That any electric lighting company, owning and operating overhead electric light wires, may put such wires under ground,' etc., not that any electric light company may come into this district, buy a lot of overhead wires and open the streets and put down electric light wires underneath its overhead telegraph wires. I have been reluctant to come to this decision, since it is manifest that the public interest requires competition in electric lighting, and the state of the art, I believe, makes it possible to furnish a cheaper and better light, but I cannot reach any other conclusion than that the Washington Electric Light Company cannot be permitted to put down electric light wires if they do not own overhead electric light wires, and so I advise you."

Storage Batteries Adopted.—The stockholders of the Metropolitan Street Railway Company, of this city, held a meeting yesterday afternoon, and decided to equip its road with cars operated by electric storage batteries. The meeting authorized the board of directors to expend not more than $500,000 in making the necessary changes. The system which will be put in operation is one owned, and controlled by the company, it being the result of a series of practical experiments conducted by the company's consulting electrical engineer, Mr. C. O. Mailloux, for more than a year past. A car constructed under the supervision of Mr. Mailloux has been running at intervals on the road, and in a general way was satisfactory. Recently it has been materially improved. New buildings for the electrical plant will be erected at once; labor-saving machinery is to be used to the fullest extent. Among the many things which will be put in will be three water-tube safety boilers, each of 200 horse power; coal and water are to be fed automatically, and the ashes removed without active human effort. There will be three Corliss compound steam engines, of 200 h. p. each, and the electricity will be generated by six dynamos, only two of which, however, will be operated at any one time. The batteries in the cars will be removed automatically, and elevated to the second story, where all transferring is to be done by mechanical means. In the recharging room, there will be 64 battery stands. One of the difficulties with which the company has contended in its electrical experiments was the weight of the batteries each car has to carry; that it is now known will not affect the grooved rails just put down, for that rail is more than equal to the strain that is put upon it; being bound on both outer edges by solid concrete, it cannot spread to any appreciable extent. V. N. B.

ENGLISH NOTES.

(*From our own Correspondent.*)

LONDON, Dec. 3, 1890.

An Interesting Legal Decision.—Appeal Court No. 1 has finally disposed of a legal point, which has argued its way up to it from Bow Street Police Court. Some little time ago the St. Martin's Vestry refused to remove the clinkers and other refuse produced in the Hotel Metropole in connection with the electric lighting of the hotel, on the ground that the clinkers were the "refuse of a trade," within the meaning of the Metropolis Local Management Act, of 1885, which states that the "refuse of a trade" is not to be removed without a reasonable sum being paid for the work. It has now been decided by the Court of Appeal that under no circumstance can ashes be held to be the "refuse of trade." This decision is of considerable importance to owners of isolated plants in large cities, where the cost of running such plants would be greatly increased, if local authorities were allowed to charge any sum they thought fit for the removal of ashes, etc.

The Reduction of Telephone Rentals.—Despite the confident assertions of the National Telephone Company that the approaching expiration of some of their more important telephone patents will in no way affect them, they are evidently preparing for somewhat altered conditions. For the past few weeks local papers have been full of announcements of telephone rental reductions. At Leeds the rates are to be reduced from the 1st of January from £15 to £10, and also at Glasgow, Liverpool, Birkenhead and Newcastle. Corresponding reductions are to be made in the trunk line tariffs. Thus, in the case of Liverpool and Birkenhead, the trunk line tariff on and after the 1st of January, 1891, will be as follows for three minutes' conversation: For any distance not exceeding 25 miles, 3d.; not exceeding 50 miles, 6d.; not exceeding 75 miles, 9d.; not exceeding 100 miles, 1s.; not exceeding 125 miles, 1s. 6d.; not exceeding 150 miles, 2s.; not exceeding 175 miles, 2s. 6d.; not exceeding 200 miles, 3s.

Subway Electric Railways for London.—I am glad to be able to say that the Central London Railway Company, nothing daunted by their failure to convince the House of Lords last session, have decided to reintroduce their bill for running a double track subway railway from the suburban district of Bayswater to the Bank of England. Your readers may, perhaps, remember that this bill received last session the hearty support of the general public, the daily press, the technical press, the House of Commons Committee and of the House of Commons itself, but that after being endangered by the selfish opposition of the big landowners and shopkeepers along the proposed route it was finally summarily rejected by the Select Committee of the House of Lords at the instance of the Bishop of London, who conjured up a dismal picture of the dome of St. Paul's at an angle of 45 degrees with the horizontal, owing to the sinking of its foundation, which he was of opinion would certainly be caused by the running of two steel tubes 11 feet in diameter and 50 feet under the clay at a distance of 100 yards from the dome. Should the bill be passed Mr. Greathead, the engineer of the City and South London Railway, will hold a similar position with regard to the present scheme, and Messrs. Mather & Platt, the electrical contractors to the City and South London Railway, will also carry out the electrical work of the new line.

The Effect of the Presence of Magnetic Rocks on Ships' Compasses.—The wreck of H. M. cruiser "Serpent," which occurred a week or so ago off Cape Villano, has given rise to considerable discussion in the daily press, each individual writer having a particular theory of his own to account for her presence at that particular spot. Professors Rücker and Thorpe have, I am glad to see, written to the *Times* showing how improbable it is that the apparent deviation from her course, which the "Serpent" had made, was in any way due to the presence of large masses of magnetic rock on the northwest coast of Spain. Such an explanation, they say, should only be accepted after a vigorous proof. In the first place ordinary iron stone is not magnetic, and secondly, where magnetite *is* present, as on the island of Canna on the west coast of Scotland, the effect diminishes very rapidly with the distance. Professors Rücker and Thorpe, as is well known, have for some years past been engaged in studying this very question of the local disturbances created by the presence of iron ore, and in 1888 they carried out several experiments with a view of testing the magnetic effect of the famous Compass Hill in the island of Canna. On one occasion they approached the island, the course of the vessel being magnetic South one-quarter East, a direction most favorable for the detection of any deviation. They passed within 200 yards of the shore, but observed no appreciable effect on the compass, al-

though a needle on the hill itself is very powerfully influenced. The professors further state that nowhere in the United Kingdom have they discovered a disturbance which extends over a mile and produces a deviation of the compass of as much as two degrees.

Railway Rates.—The Board of Trade has for some time past being endeavoring under powers conferred upon it by a recent act of Parliament to adjust the long standing differences of opinion which have existed between traders and the great railway companies, as to the rates to be charged for merchandise, machinery, etc. A lengthy inquiry was held in the summer at which the leading industries of the kingdom and the leading railway companies were represented, and each article carried by the railway companies was discussed from both sides, the traders endeavoring to show cause why the rates should be reduced in each case, and the railway companies trying to show why the present rates or only slightly reduced rates should be enforced. The outcome of the inquiry has been the publication by the Board of Trade of a schedule of maximum rates and charges, which they propose to have confirmed by act of Parliament next session. As is generally the case in such matters, this schedule has not satisfied the traders while it has caused considerable indignation among the great railway companies of the kingdom, who allege that if these maximum rates are enforced their dividends will be reduced to a vanishing point. This question is of considerable interest to the electrical industry. Some electrical apparatus is absurdly classified by the railway companies, electric light cables, uninsulated copper wire, insulators and accumulator plates being especially subject to the displeasure of the companies' traffic managers.

News of the Week.

THE TELEGRAPH.

Dividend.—The New York *Morning Journal* of Dec. 7 says: "Two men who have a right to be happy just now are John W. Mackay and Manager George G. Ward, of the Commercial Cable Company. Amid all the Wall street stringency the company's shares held firm as a rock, and with good reason. Its latest declared dividend of 1¾ per cent. shows that it has become a 7 per cent. stock—a triumph for pluck, good service and good management."

Death of an old Telegrapher.—Mr. J. T. Sayward died in Charlestown, Mass., Saturday, Dec. 6. Mr. Sayward, who was 39 years of age at the time of his death, has been connected with the telegraph business for nearly a quarter of a century, and for many years prior to his resignation last September, owing to ill-health, was manager of the Gold and Stock Telegraph Company's central office in the old board of trade building on State street and at 35 Congress street, Boston. Mr. Sayward was a member of the Telegraphers' Mutual Benefit Association.

THE TELEPHONE.

Dividend.—The Bell Telephone directors have declared the usual quarterly dividend of $3 per share, payable Jan. 15 to stockholders of record Dec. 31.

Increase of Net Earnings.—Erie Telephone net earnings increased in October, 1890, $7,498.48 over October, 1889. The net gain of subscribers in October was 125. Total number connected Nov. 1, 13,052.

THE ELECTRIC LIGHT.

The Brookline (Mass.) Gas Light Company has declared a semi-annual dividend of 3½ per cent.

The Edison Electric Illuminating Company, of New York, has declared a quarterly dividend of one per cent.

Wilmerding, Pa.—The electric light plant at Wilmerding, the new town near Pittsburgh, where the Westinghouse Air Brake works are located, is now being increased from a capacity of 1,200 to 2,000 lights.

Hamilton, Ont.—The Electric Light and Power Company, of Hamilton, has leased the business of the Hamilton Electric Light Company and has engaged Mr. W. J. Clark, of Trenton, Ont., as General Manager. Mr. Clark has had large experience in electric lighting, and has been connected with one of the largest companies in the United States.

Westinghouse Business.—Since the first of December, the Westinghouse Electric and Manufacturing Company has received contracts for alternating current electric lighting apparatus for a capacity of 5,650 incandescent and 120 arc lights. Olean, N. Y., has contracted for an increase of its plant and when the apparatus has been installed the plant will have 1,400 incandescent lamps capacity.

Search-Light Photograph.—Herman Lemp, of the Thomson Electric Welding Company, Lynn, Mass., has taken an excellent photograph of the Lynn Co-operative Supply Company's store. The picture is clear and distinct, and what makes it most interesting is the fact that it was taken at night by the aid of the huge flash or search-light made in the Thomson-Houston Electric Company works.

Delaware, O.—The Delaware Electric Light and Power Company is now in running order and has two 50-light Thomson-Houston arc machines, one 650-light Thomson-Houston alternating incandescent, two 150 h. p. Buckeye engines, three 150 h. p. boilers, and one Dayton heater. The power house is 48 × 80 feet, built of brick, and is one of the nicest in Ohio. The company has just secured a contract from the city for 37 lights. The gas company holds a contract for a part of the city, which expires in 1893, at which time the company expects to sell about 45 lights more.

A Railroad Company's Plant.—The Pennsylvania Railroad Company is rapidly increasing the number of electric light plants along its lines, where a good light is of the greatest consequence and advantage to the railroad. Some time ago, the Westinghouse Electric and Manufacturing Company installed a plant of its alternating current arc light apparatus at the Altoona shops. The operation of that system has given such satisfaction that the railroad management lately decided to have a similar plant put up at Wall Station, which is one of the most important points on the entire Pennsylvania Railroad system. The plant will have a capacity of 120 arc lamps.

November Sales.—The following sales were made by the Central Station Lighting Department, Chicago, Ill., of the Thomson-Houston Electric Company, during the month of November, 1890: Marmon & Perry Light Company, Indianapolis, Ind., 2,000 incandescent; C. W. Kimball, Maywood, Ill., 500 incandescent; Alpena Electric Company, Alpena, Mich., 1,300 incandescent; Gilchrist & Dresie, Seneca, Kan., 500 incandescent; J. R. Hamacher & Bro., Richmond, Mo., 650 incandescent; Mt. Pleasant Electric Company, Mt. Pleasant, Mich., 650 incandescent; Lansing Gas Company, Lansing, Mich., 650 incandescent; Pierce City Water Company, Pierce City, Mo., 300 incandescent; Lamar Water and Electric Light Company, Lamar, Mo., 650 incandescent and 50 arcs; Oakland Gas Light and Heat Company, Oakland, Cal., 50 arcs; Owosso Electric Light Company, Owosso, Mich., 60 arcs; Badger Illuminating Company, Milwaukee, Wis., 100 arcs; Vivian, Stribling & Co., Norborne, Mo., 30 arcs.

APPLICATIONS OF POWER.

Leeds, Mass.—The electric power plant, which the Nonatuck Silk Company has been building at this place for running motors at its mills, is now in running order. The wires have been run from the motor at the Cook dam up to the mill at Haydenville, which is soon to be started up.

The Tramway Construction Company has been formed in New Haven, Conn., with a capital stock of $20,000, to construct street railways in the eastern part of the State. E. P. Shaw, of Newburyport, Mass., and S. Harrison Wagner and Frank H. Kelley, of New Haven, are directors.

The Short Electric Railway Company, of Cleveland, Ohio, has the following contracts for the first ten days in December: Pittsburgh & Birmingham Traction Company, Pittsburgh, Pa.; Broadway & Newburgh Street Railway, Cleveland, Ohio; Jamestown Street Railway Company, Jamestown, N. Y.

Beverly, Mass.—The selectmen of Beverly have just decided that the Naumkeag Street Railway Company can not put an overhead electric system into Beverly, and now a movement is on foot at Beverly Farms in the form of a petition, which will ask the selectmen to allow the Naumkeag road to extend and equip its line with electricity from Beverly Cove to the Farms.

November Shipments.—The following shipments of motors were made from the Chicago office of the Thomson-Houston Electric Company in November: F. S. Sargent, Omaha, Neb., one 1½ h. p.; John Campbell & Co., Detroit, Mich., one 1½ h. p.; A. F. Walker, Grand Rapids, Mich., one 1½ h. p.; A. F. Walker, Grand Rapids, Mich., one 5 h. p.; L. M. Hodges, Chicago, Ill., one 10 h. p.; Union Depot Railway Co., St. Louis, Mo., one 20 h. p.; A. F. Walker, Grand Rapids, Mich., one 1½ h. p.

Directors of a Road.—The stockholders of the Merrimac Valley Street Railway Company, at their annual meeting the 9th inst., at Lawrence, Mass., elected these directors: W. B. Ferguson, Boston; E. P. Shaw, Newburyport; J. H. Cunningham, Chelsea; A. D. Bisson, Chelsea; J. H. Eaton, Lawrence; William Oswald, Lawrence; N. E. Morton, Lawrence. W. B. Ferguson was chosen president, and A. E. Butler secretary and treasurer. In the spring a line will be built between Andover and Lawrence, and the whole system equipped with electricity.

New Street Railway.—Articles of incorporation have been issued by the Secretary of State to the Chicago, Blue Island and Harvey Street Railroad Company to build and operate a street railway from Blue Island to Chicago, with a possible continuation to Harvey. The capital stock of the company at present is $250,000. Two of the incorporators, E. H. Rexford and Andrew Reiner, are largely interested in real estate at Blue Island. This is part of the improvement scheme which is being quietly agitated in the section north of Blue Island along the ridge. This scheme includes the Chicago Central Railroad now being built, the boulevarding of Western avenue from Blue Island north to the Fifty-fifth street boulevard and an electric line running parallel to the Chicago Central Railroad.

The annual meeting of the Second Avenue Electric Railway Company of Pittsburgh was held Dec. 1. A part of the proceedings was the election of officers for the ensuing year, which resulted as follows: President, Jas. D. Callery; Secretary, Chas. G. Milnor; Treasurer, Jno. M. Taylor; General Manager, William J. Burns. The net earnings of the road for nine months, under the operation of the electric system amount to $2,227.65. Here another instance of the advantage of rapid transit, to the street car corporation as well as to the public, appears. Under the horse car regime, this Second Avenue line was a losing investment constantly, and bankruptcy was ever staring the concern in the face. To-day, as will be observed, the figures are on the other side of the ledger, and it is a well known fact to all well informed Pittsburghers that the future prospect of the company is very good.

Nashua, N. H.—A large part of the Nashua Manufacturing Company's new electric railway is already in operation. The cars on the track laid from the cloth packing rooms to the storehouse are running. The track from the storehouse to the cotton house and the mill is being rapidly put in and will probably be in running order in the course of a week or so. The narrow gauge track that runs from the mill to the cloth house is finished and now only awaits the arrival of the car. The car in use on the wide gauge in operation is substantially built of wood with iron bands. It will hold eight large size cases of cloth and make the trip from one end of the line to the other in a fraction less than two minutes. It is run by two 3-horse motors, a 30 h. p. dynamo supplying the current. The whole system is very conveniently arranged and when in full operation will make a great saving of time and labor.

Robinson Radial Cars.—The Boston *Herald* of a recent date says: "Of the Robinson radial cars ordered by the West End Railway Company, 14 of the car bodies are already completed, and 35 more are well under way. The radial trucks for these car bodies are beginning to arrive at the central power station, and within a few weeks a large number of the radials will be running in the streets of Boston. The car bodies are 25 feet long, and will comfortably seat 17 to 18 passengers on a side. The height of the car bodies will be the same as in the radials now in use, that it is, seven inches lower than the eight-wheel cars. Col. George Truesdell, president of the Eckington & Soldiers' Home Railway, Washington, D. C., recently made some careful, scientific tests with one of the Robinson radial cars having a 26 foot body, which he has on his road, and he states that in climbing grades the radial requires, on an average, 2 h. p. less than the ordinary 4-wheeled cars. This is corroborative of the facts observed in connection with the running of the radials in Boston."

PERSONALS.

Mr. Albert Scheible, formerly with the Strong Lamp Manufacturing Company, of Cleveland, O., and lately with the Great Western Electrical Supply Company, of Chicago, is now Mr. George Cutter's assistant in The Rookery, Chicago.

Mr. Henry C. Eddy, well known to many of the electrical fraternity in Chicago, has assumed charge of the Western branch office of THE ELECTRICAL WORLD at 465 The Rookery, Chicago, vice Mr. Fred DeLand, who has been transferred to the home office, 167-177 Times Building, New York.

MISCELLANEOUS NOTES.

Stephen Gray.—Mr. Park Benjamin has an interesting sketch in the New York *Herald* of Sunday, relating to the early work of Stephen Gray 170 years ago. The concluding paragraph reads: "Gray's last memoir relates mainly to the curious light which appeared at the end of his conductors and to the strange explosions which occurred there—all to him 'singular manifestations of the electric fire.' So singular indeed, as even to seem 'to be of the same nature with that of thunder and ligning.' This was the first suggestion of the identical character of lightning and electricity. Whether in him there would have been an earlier Franklin no one knows, for here his life and his experiments ended coincidently. The two great discoveries of conduction and insulation are enough to win a full measure of fame for any man, no matter how tardily they may be recognized as his, for the endless cobwebs of wire and their glass supports which carry the signals of the telegraph all over the face of the earth, or the slender copper thread imbedded in the rubber which serves as a path for the current under thousands of miles of ocean, are but repetitions of Gray's pack thread line with its silk support."

Industrial and Trade Notes.

The New Process Raw Hide Company, of Syracuse, N. Y., which manufactures improved raw hide gears, has just increased its capital and is now enlarging its plant.

Bradner Adjustable Hanger.—The Electrical Supply Company, 171 Randolph street, Chicago, reports that the commercial success of the Bradner adjustable lamp hanger rivals "its mechanical and esthetic supremacy."

The Shipman Automatic Steam Engine Company, of Rochester N. Y., has just shipped one of its two h. p. engines to Mysore, India, and one 22 h. p. compound and one eight h. p. compound to California, to Osborn & Alexander.

The Gilbert Car Manufacturing Company, of Troy, N. Y., manufactures the Taylor truck, and also a patent non-oscillating truck, and is now furnishing cars for street railways in the following cities: Rochester, N. Y.; Pittsburgh, Pa.; Buffalo, N. Y.; Youngstown, O.

George W. Tifft & Son have just furnished one of their steam engines of 40 h. p. to the Northern Steamship Company for use on the "Northern Wales," to run the electric lights. Also one 50 h. p. for electric lighting at the State Hospital for the insane. The first of these plants has a capacity of 150 lights and the second of 250.

The Eureka Tempered Copper Company, of North East, Pa., was awarded the John Scott medal by the Franklin Institute of Philadelphia, at the November meeting. The company reports large orders received for its goods for electrical purposes and for bearings, and has been compelled recently to double the capacity of its plant.

Knowlson & Kelley, of Troy, N. Y., are builders of Corliss engines, and have just shipped a 150 h. p. engine to the Johnstown & Gloversville Electric Light and Power plant, N. Y. This firm is doing an extensive business in the manufacture of engines for electric light work, and is at present making the machinery for the Troy Electric Dynamo Company.

The Rochester Machine and Tool Works, at Rochester, N. Y., are the manufacturers of the Acme automatic safety engine. This company has a large number of these engines running in connection with small electric light plants. In some stations it is said that 65 lamps are run from a 400 h. p. engine. An extremely sensitive governor is provided by which a perfectly steady light is made possible.

The Bridgeport Machine Tool Works, of Bridgeport, Conn., have just issued a new and elaborate catalogue in which they illustrate and describe a line of machine tools for general machine shop and manufacturing purposes, which are guaranteed to be first-class in every respect. Their facilities have been largely increased during the present year, so that they are prepared to execute orders promptly.

The Revere Rubber Company, of Boston, Mass., has established an electrical department and has placed the general Western agency in the hands of Mr. Geo. Cutter, 333 The Rookery, Chicago. Designs and estimates will be furnished for all kinds of both hard and soft rubber work and special facilities have been prepared for the manufacture of odd shapes and sizes so often required in electrical work.

The Electrical Construction and Repair Company, of 203 Canal street, Chicago, will shortly place on the market an exceedingly clever trail car connector, which will commend itself to railway men on account of its simplicity, positive action and from the further fact that there is no current in the parts until the connection between the cars is completed, thus avoiding the danger of receiving unpleasant shocks.

The Fishkill Landing Machine Company, of Fishkill-on-the-Hudson, N. Y., well known as the builder of the improved Fishkill Corliss engines, boilers and machinery, has recently furnished the West Shore Railroad Company at Weehawken, N. J., one 800 h. p. vertical direct acting engine, and is now building a similar one for the New York Central & Hudson River Railroad, to be used at Sixtieth street, in this city.

The C. McIntire Company has just completed and shipped a large order to Carl Dahl & Co., Copenhagen, Denmark, and has recently furnished the Edison General Electric Company, of New York, with a large stock of electric light connectors, from Nos. 6 to 16 inclusive, and is receiving large demands for its new patent fuse terminal with split tube that can be replenished when the old fuse wire burns out with a new one.

William Wright, of Newburg, N. Y., builder of Wright's patent automatic cut-off steam engine, has one tandem compound 500 h. p. engine in use in the Municipal Electric Light Company station in Brooklyn, and one 400 h. p. of the same type in the station of the Citizens' Electric Light Company, of Brooklyn. Mr. Wright furnished the engines for the Brooklyn Bridge, and he will also be remembered as the inventor of the "rotative valve."

The Electrical Supply Company, 171 Randolph street, Chicago, say: "The growing demand for Shield brand line wire is due simply to the fact that the public is becoming satisfied that the wire is really moisture-proof far beyond the requirements of practical use. A large sale for such a wire was a foregone conclusion once the skeptics could be convinced that Shield brand is moisture-proof for something more than advertising purposes."

J. M. Jones' Sons, of West Troy, N. Y., are now manufacturing a large number of cars for the West End Street Railway, of Boston, Mass., for use on that company's electric lines. The length of the car body is 25 feet, and each car is equipped with a pair of four-wheel trucks to which will be fitted electric motors. The same company is building similar cars for the West End road to be equipped with Robinson radial trucks; these will have six wheels and will be fitted with two motors. The J. M. Jones' Son

are well known as builders of street cars for all classes of power, whether horse, cable or electric, and, having been in the business for over 50 years, are able to furnish cars in which are combined all the latest improvements.

Catalogues Wanted.—Major Dr. Antonio de Souza Aguiar, Engenheiro, Estacao Central, Corpô de Bombeiros, Rio de Janeiro, South America, is desirous of securing a full set of catalogues and pamphlets from various electrical supply and manufacturing companies; and from the lighting interests also. We understand that the Major may probably influence the purchase of a considerable amount of machinery before long, and correspondence with him may prove beneficial.

Mr. A. H. Patterson, of the Phœnix Glass Company, 729 Broadway, was found as busy as ever one day the past week looking out for the large orders in globes and shades from all over the world. An order from China or Siam is not an unusual occurrence. Mr. Patterson exhibits one from China that is written on parchment paper. He has lately received orders from Siam, Japan, Sweden, Australia, Turkey, and other far off countries, some of which were for large consignments of goods.

The Star Headlight Company, of Rochester, N. Y., manufacturer of headlights, railroad signals, lamps and lanterns, is furnishing its electric headlight for electric street cars to a considerable extent. The company has recently equipped some of the cars of the Albany Street Railway, the Troy & Lansingburg Railway, the Bangor (Me.) Street Railway, the New Orleans (La.) Street Railway, and the Pittsburgh (Pa.) Street Railway with these headlights. Mr. E. C. Glazier is president and superintendent of the company.

J. H. Dotzert, Newburgh, N. Y., is the manufacturer of the "Bergman Battery," claimed to be superior on account of its patent sealing device, which keeps the solution clean and prevents its loss by evaporation or otherwise. It can be safely transported with all its contents intact. Mr. Dotzert has a new and commodious factory on Chambers street, and is prepared to furnish these batteries in quantities to the trade. Mr. Dotzert is the electrician of Newburgh, has a full stock of electric supplies, and does all wiring for houses, factories, etc., in the place.

R. Thomas & Sons, East Liverpool, O., have issued a neat catalogue showing a complete line of hard vitreous electrical supplies, such as insulators, branch blocks, cut-out bases, etc. They claim that the body and glaze are both composed of earthen materials, and the body being thoroughly vitreous is fully as good an insulator and non-conductor without the glazing as with it. Furthermore, that all these goods being fired with the aid of natural gas in a temperature of about 4,000 degrees Fahrenheit, are rendered fire, acid and water-proof, and absolutely non-absorbent.

Mr. Robert Keasbey, general manager of the New York branch of the Magnesia Sectional Pipe and Boiler Covering Company, 58 Warren street, is meeting with excellent success in his line, and gives particular attention to covering electric light and power plant boilers, pipes, etc., and refers with pride to the numerous companies he has done business with. He has just completed the covering of all the steam pipes, etc., of the new electric light plant at the New York entrance to the Brooklyn Bridge; also the steam plant of the Rapid Transit Street Railway, Newark, N. J.

The Automatic Battery Company is exhibing a full line of medical and other batteries at its salesrooms and offices, 703 Broadway, this city. The penny-in-the slot automatic batteries are taking exceedingly well throughout this city, over 300 being now in use. The company is selling city and State rights. The right for a large Southern city has just been disposed of. The automatic batteries are got up in handsome cases and made very strong and durable as well as to stand dampness, as they are made to put outside of stores, offices, etc. The customer drops a penny in a slot, pulls the handles and gets an electric treatment. The Automatic Battery Company will be pleased to send a fully illustrated circular of these electrical devices.

The Broadway Electric Company, 703 Broadway, this city, has the only electrical exchange in this city with everything electrical, from an electric light station outfit to a horseshoe magnet. The company will buy or exchange for any special piece of electrical mechanism in an unfinished state and manufacture electrical moving figures of all kinds, having in stock many varieties of figures representing various lines of business as well as novel designs for store window attractions and advertising novelties to suit any trade. These are made to order also from any design furnished. The company also manufactures and keeps in stock every variety of medical battery, as well as open and closed circuit batteries of all kinds, and all kinds of electrical supplies for household and office use.

Pass & Seymour, Syracuse, N. Y., are now doing business in their new gigantic works especially equipped for making all kinds of high-class china (or porcelain) specialties, cut-outs, switch bases, lamp collars and bases, and are furnishing large quantities for the Schuyler Electric Company, Thomson-Houston Electric Company and others. They received orders one day last week for 145,000 pieces. They have tools and machinery for making dies of the most difficult patterns. Their china is well known for its strength. Mr. Pass illustrated this by throwing some of the pieces against the brick wall with great force without injury to the china. Some of their customers rivet the brass work to the china, subjecting it to great strain. One piece of their work is illustrated on another page. They furnish any color to match woodwork.

Shultz Pulley Covering.—Heretofore, in covering pulleys with leather, it has been customary to drill holes in the face at each edge of the pulley and rivet the leather on; but in covering a pulley in that way, it is difficult to keep the air from getting under, and eventually breaking it out at the rivets. Besides, so many rivets being necessary to cover a pulley, prevent the proper adhesion of belt to pulley, and also cut out the belt, and to drill the holes the pulley had to be removed from the shaft, taken to a machine shop to be bored, and returned again to the shaft after covering. The Shultz Patent Covering being wider than the pulley face, its edges are brought over the edges of the rim and then turned toward each other and fastened on to malleable iron segment clamps, with teeth to hold the leather; the clamps are placed around the pulley under the rim, and drawn together by a quarter-inch bolt, which draws the leather tight over the face and edges of the pulley. In this way the leather can be drawn on the face of the pulley as tight as a drum-head, as the process of drawing is in a degree similar, and should the covering ever become loose it can be tightened in a few minutes, simply with a screw-driver to turn the bolts.

A Prosperous Firm.—One of the new and enterprising firms that have lately entered the electrical field is the American Electric Supply Company, of Buffalo, N. Y. This firm is now fairly established in its large and commodious store at 226 Pearl street, where it has two floors filled with everything imaginable in the way of electric light, power, railway and general supplies. Its business for the past two months has been far ahead of its expectations. This company is agent for the Simplex wire, the C. & C. motors and the electric railway goods manufactured by the Electric Merchandise Company, of Chicago. The construction department is also very busy, some of the contracts being isolated plants for the Snow Steam Pump Works and the Buffalo Alcholine Works of Buffalo, a central station of the Ft. Wayne system for the town of Fredonia, N. Y.; 500 incandescent lights at Austin, Pa., and the wiring of the new Sage Library at Cornell University, Ithaca, N. Y., for nearly 1,000 incandescent lights. The officers of the company are: Chas. M. Proctor, president; S. C. Baynes, vice-president; Paul C. Ransom, treasurer; W. L. Adams, secretary and general manager. The firm will be represented on the road by Mr. Walter P. Weinstein. Mr. Adams was formerly manager of the Buffalo branch of the North American Construction Company, of Pittsburgh, representing the Westinghouse interests in this section, and is a man of well-known ability and one who has had an extensive experience in electrical matters and general engineering.

The India Rubber and Gutta Percha Insulating Company, 159 Front street, nearly one year ago purchased all the factories of S. S. Hepworth & Co., manufacturers of sugar machinery at Yonkers-on-the-Hudson, comprising eight large buildings with about 350 feet water front and 200 feet deep. Mr. W. M. Habirshaw, general manager of the company, has been remodeling the interiors to suit the purposes of the company in the manufacture of high class insulated cables and wires for use in submarine, marine and underground electric lighting, vulcanized india rubber, pure rubber and all special insulations to order; also all kinds of house wires, flexible cords in cotton and silk of any capacity. Mr. Habirshaw, F. C. S., of London, also a member of the leading chemical societies of New York, with the knowledge of all the requirements necessary to produce a first-class insulation, has brought the company's goods to a high standard, and they have become so popular as to necessitate an enlargement of the works. With the new facilities the company will be enabled to carry a large stock of all its goods, thus enabling it to fill all orders promptly. The company will have every convenience for shipping, either by rail or water, as the Hudson River is located on one side and the Hudson River Railroad on the other. It is said that this will be the largest and most complete factory for producing insulated cables and wires in this country. The company took orders in one day for 350,000 feet of assorted sizes of vulcanized india rubber wires for general electric light use. The company also has large orders for marine core wire for United States cruisers; also underground cables for the Buffalo underground system for electric railway use. Mr. William Habirshaw is superintending the manufacture of all the productions of the India Rubber and Gutta Percha Insulating Company.

Answers to Correspondents.

Application of Electricity to Railways.—In the issue of London *Electrician*, Nov. 14, 1890, under the heading of "Paris Notes," the following appears: "At meeting of the Société Internationale des Electricians on Wednesday, last week, M. G. Dumont read a long paper on the "The Application of Electricity to Railways, etc." Can you inform me through your valuable publication where I may read the paper in question? RAILWAY.

The article in question will in due time appear in the publications of the society mentioned; an abstract of it may be found in *La Lumière Electrique* of Nov. 15, 1890.

Gelatinous Electrolytes.—Can you give me any information about the nature and the manner of preparing the gelatinous electrolytes used in the Schoop accumulator?

We do not know the exact nature of Dr. Schoop's preparation, which you might perhaps find from his patent specifications, which we could order for you if you desire them. It is presumably formed of a soluble silicate, which is the usual gelatinous medium where acid is to be employed, since organic matter will stand only very slight acidulation.

Various Queries.—1. Is the drop of voltage on a line greater in cases of low voltage than in high potential current? 2. At what cost per hour for running 16 h. p. incandescent lamps from primary batteries would this source of electricity be deemed a practica success? 3. Where does aluminium rank in the list of electro-positive and negative elements? 4. What battery now on the market gives the greatest ampèreage from a cell of given weight? F. C. B.

1. The drop on the line is proportional to the resistance of the line, and the current is greater in the case of low voltage only as the current employed has to be somewhat larger than with high potential current. 2. This depends on the purpose for which lights are to be obtained. A primary battery that would give a 16 h. p. lamp at two cents per lamp hour with comparatively little trouble in taking care of it, would find a wide sphere of usefulness in domestic lighting. The trouble with primary batteries for this purpose has been high cost, and the necessity for frequent attention. 3. Between zinc and magnesium. 4. This would lie between a specially light storage battery and a Grove or bichromate battery of small resistance. Probably the latter would give the largest current for a given weight. A cell used by Tissandier was capable of giving over 100 ampères on short circuit.

Magnetization.—Here is something which has puzzled me long time, and, although I have studied everything on the subjec I can find, I have been unable to solve the problem. If you wil kindly do so for me I think it will benefit others beside myself, and I shall feel very grateful: 1. According to Hopkinson's formula $4\pi nc = lf\left(\frac{I}{A}\right)$, etc., so long as l and the *ratio* of I to A are unaltered, I and A may be increased without changing the value of $4\pi nc$. That is, if the length of magnet core (l), and the number of lines of force per square centimetre (B) are kept constant, the *total* number of lines of force (I), and the sectional area (A) of the magnet may be both increased without making the magnetizing force ($4\pi nc$) any greater. I cannot understand this, because in practice a 5 and 10 h. p. may have magnet cores of the same length (but different cross-sectional area) and same number of lines of force per square centimetre, but the magnetizing force required for the large motor is considerably greater than for the smaller one. 2. In Parshall's article on "Magnetic Data of Sprague Street Car Motor" some three or four months ago, are the curves for magnetism in the armature or field? LAZELLE.

1. Hopkinson's formula is all right. With a given magneto-motive force, that is, a given number of ampère turns around the magnet, the total induction varies with the permeability of the materials and with the cross-section of the magnet. In other words, the induction depends on the magnetic resistance of the circuit. If this is lowered by increasing its cross section the same magneto-motive force will produce a largely increased total induction. It is precisely like the case of current delivered from a battery; the electromotive force does not have to be raised to give an increased current, provided the resistance is lowered. The energy consumed in magnetization will vary according to the character of the winding employed. The reason for the discrepancies you mention in cases met in actual practice is to be sought in the change in magnetic resistance; in most machines the magnetic resistance of the air space is a very important factor and a slight change in clearance or depth of winding of the armature may counteract advantages gained from an increased cross-section of the magnetic core. 2. The curves are for the total magnetism, in other words, the characteristics of the machine as it is used.

Business Notices.

Complaints of gas lighting plants stopped by our battery cut-out. Cheap, sensitive, reliable. Electric Supply Company, 105 South Warren street, Syracuse, N. Y.

Intelligent people, who are familiar with the respective advantages which are offered by the several competing railroad lines between Chicago, St. Louis and Kansas City, and who desire to travel with the utmost speed, safety and comfort, always take the popular and reliable Chicago & Alton Railroad between these points, and passengers going to or coming from the South, via St. Louis, or when going to or coming from the West, via Kansas City, should insist upon having tickets that read over the Chicago & Alton. It is the only road with three complete and elegantly equipped trains daily between Chicago and each of the points named, and no railroad managers in America have a more intelligent appreciation of the wants of the traveling public than do those of the famous Chicago & Alton.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS

U. S. PATENTS ISSUED DEC. 9, 1890.

442,104. Electrical Signal for Engines; Michael Conley, of Chicago, Ill., Assignor of two-thirds to James C. Ricketson and Frederick B. Rickertson, of Milwaukee, Wis. Application filed Oct. 3, 1889. The combination, with a reversible engine and a distant signal in circuit with a metallic part of said engine, of electrical contact points mounted upon the engine and made and broken directly by a movable part of the engine.

442,126. Electrical Volt Recorder; Sylvanus D. Locke, of Hoosick Falls, N. Y. Application filed May 7, 1889. In an assembly-chamber, the combination of a series of desks provided with aye and nay keys, an index-board laid out into numbered compartments corresponding to each of said desks and with two binding-posts in each compartment, one for the aye and one for the nay key, independent wires leading from said keys to the corresponding binding-posts in that division of the index-board bearing the number of the respective desk, an annunciator containing magnets and armatures, two for each desk, and corresponding to the alphabetical occupant of that desk, and switch-wires leading from such magnets to the binding-posts upon the index-board in the numbered compartment of that desk.

442,127. Hanging Device for Electric Arc Lamps; James A. Lounsbury, of Chicago, Ill., Assignor of one-half to G. A. Edward Kohler, of same place. Application filed July 23, 1890. The combination of an adjustably suspended lamp, having lamp contacts of annular form carried thereby, and circuit contacts comprising arms having bifurcated ends adapted to embrace the lamp suspending medium, and to engage the lamp contacts carried thereby.

442,139. Multiple Telegraph or Telephone; Abner M. Rosebrugh, of Toronto, Can., Assignor to the American Bell Telephone Company, of Boston, Mass. Application filed Nov. 27, 1886. The combination, in a system of telephonic communication, of a metallic or double parallel line-circuit extending between two or more stations, local circuits including telephone apparatus connected by means of induction coils with both sides of the said double line main circuit, and earth branches including telephones connected with the said metallic circuit stations thereof, and at a point between the said induction coils, whereby the stations inductively connected to communicate with one another, to the exclusion of the earth-branch stations, and vice versa.

442,140. Circuit for Electric Railways; Frank W. Sabold, of Albany, N. Y. Application filed Sept. 22, 1890. In an electric railway comprising an overhead conductor or trolley wire, a motor car provided with electrical conductors by which the electric current is carried to the motor and thence into the track rails, a series of electric conductors fixed in the ground in proximity to the track rails, and connected to the latter by means of electric conductors, whereby a varying length of the electric circuit is automatically effected.

442,143. Multiple Switchboard System; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Oct. 15, 1888. The combination, with metallic-circuit telephone lines looped together in metallic circuits by a pair of loop plugs and flexible cords, of a branch circuit to ground from the strand connecting the sleeves of the plugs, said branch including a self-induction coil and a battery, said telephone lines being connected each with different switches on each of two or more switchboards and the sleeves of said plugs being connected, respectively, with the test pieces of the switch of the respective lines, whereby the test battery is connected to said test pieces, while the flow of induced currents upon the metallic circuit is prevented.

442,144. Telephone Exchange Apparatus; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Nov. 23, 1888. A metallic telephone-line circuit consisting of two branches, one branch being normally connected with ground at the subscriber's station, and thence through the subscriber's bell to the telephone-switch, and thence to the central office, said branch being connected with the test portion of a socket on each of two or more switchboards and being normally open, while the other branch, being normally open at the subscriber's station, extends to the other terminals of the same sockets on said switchboards, and thence through an annunciator and a battery to ground, in combination with the telephone switch and a ground key at the subscriber's station, whereby on depressing the grounding key current from the battery is sent through the individual annunciator, while on operating the telephone switch the two branches are united in metallic circuit.

442,145. Multiple Switchboard System; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Nov. 23, 1888. The combination with a metallic circuit telephone line connected with switches on two or more switchboards, one branch of said metallic circuit being normally open at the central office, and the other branch being normally connected through an individual annunciator to ground, of a single wire circuit connected with switches, one on each of the switchboards, and through an annunciator to ground, the frames or test-pieces of the switches of said single line being connected together and through resistance to ground, and operator's connecting, switching and testing apparatus, whereby the two telephone lines may be tested and connected together.

442,146. Telephone Exchange Apparatus; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Dec. 10, 1888. The

combination, with two subscriber's stations, of their metallic-circuit telephone lines looped together to form a single metallic circuit for conversation free of resistance, except the telephones, the different sides of said metallic circuit being provided with a branch circuit, each such branch circuit containing the individual annunciator of its line, each annunciator constructed to operate as a self-induction coil, and each of said branch circuits being connected to a ground branch, including a battery.

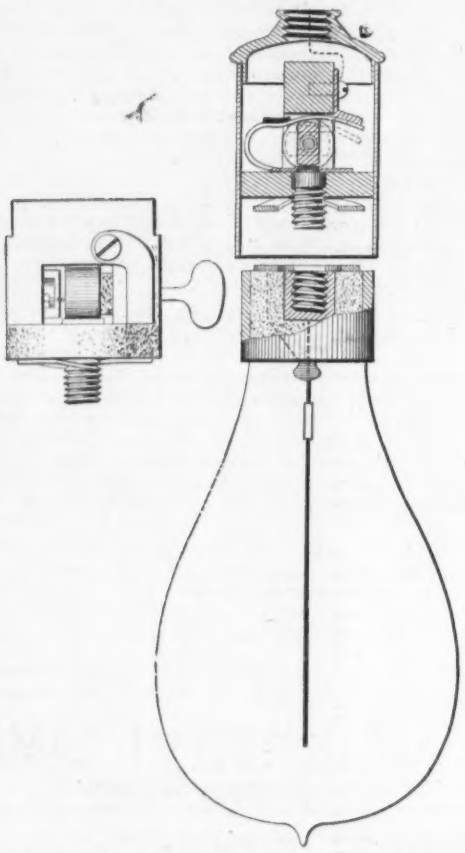
442,155. Insulating Covering for Pincher Handles; Geo. F. Virtue, of Boston, Mass. Application filed July 31, 1890. An insulating cover to be applied generally to pincher handles, consisting of a rubber tube shaped with a taper to adapt it to the ordinary form of handle, and provided with one thin side, by which it is adjusted and by which the wear comes upon the part having the least tension.

442,162. Underground Electric Conduit; Homer H. Young, of Kansas City, Mo. Application filed June 23, 1890. A conduit for underground conductors, consisting of an outer conduit composed of jointed sections, an inner conduit of similar structure, but whose joints do not lie in the same transverse plane as the joints of the outer conduit, packing interposed between the two suspending plates within the inner material surrounding all such conductors, and lids upon the sections of such conduits grooved to receive the upper edges of the lower portion of the conduit.

442,173. Electric Motor or Dynamo Electric Machine; Charles E. Dressler, of New York, N. Y. Application filed April 14, 1890. In an electric motor or dynamo machine, in combination with an outer armature, a field magnet within the same composed of cylindrical sectors of like polarity connected to sectors of opposite polarity by cores wound with exciting coils of insulated wire within a zone separating said sectors.

442,187. Method of and Apparatus for Manufacturing Secondary Battery Electrodes; James G. Johnston, of Denver, Colo. Application filed Aug. 15, 1890. The process of forming secondary battery plates having a perforated metallic envelope or supporting case, which consists in separately striking up and perforating the metallic sides of the plate, and then assembling said sides and the active material in a dry state upon the punching die, and finally compressing the whole together in said die as and for the purpose intended.

442,203. Separating Diaphragm for Electrolytic Cells; Isaiah Roberts, of Brooklyn, Assignor of one-half to Thomas H. McGraw, of Poughkeepsie, N. Y. Application filed March 14 1889. In an electrolytic cell, the combination, with the electrodes,



No. 442,287.—INCANDESCENT LAMP SOCKET.

of an intermediate partition or diaphragm having a relatively high electrolytic resistance

442,204. Diaphragm for Electrolytic Cells; Isaiah L. Roberts, of Brooklyn, Assignor of one-half to Thomas H. McGraw, of Poughkeepsie, New York. Application filed March 14, 1889. A diaphragm or electrolytic partition composed of asbestos freed from soluble constituents.

442,208. Speed Regulator for Electric Motors; William W. Schiffmann, of St. Paul, Minn. Application filed April 28, 1890. In a dental-engine hand-piece, a series of graduated contact plates embedded therein and in electrical connection with a rheostat, a motor in electrical connection with said rheostat and adapted to actuate the shaft of said hand-piece, a commutator adapted to be moved over said contact plates, said graduated contact plates and commutator being placed near the outer or burr end of said hand-piece, so that said commutator may be actuated by the fingers or thumb of the hand which holds the hand-piece and without releasing its hold therefrom or changing its relation thereto.

442,232. Attachment for Span Wires for Suspended Electric Conductors; Frank Mansfield, of New York, N. Y. Application filed April 26, 1890. In a device for raising and lowering span wires, the combination, with a pole, of a horizontally arranged polygonal-shaped block mounted upon the outer face of the pole and adapted to be moved up and down thereon by rotation of the block, and a span wire connected to the block, so as to be vertically adjusted by the movement of the block.

442,267. Telegraphy; Edward B. Ives, of New York, N. Y., Assignor to James M. Seymour, of same place. Application filed Feb. 24, 1890. The combination of a main line conductor extending between two or more stations, means for the simultaneous transmission of electrical impulses in opposite directions, a circuit breaker interposed in the main line between the main line conductor and the main line wire of the transmitting devices and composed of two contact devices, one divided into sections connected, respectively, to said main lines wire, the other contact device thereof being connected to the main line conductor, and one of them being adapted to move across the face of the other, a similar circuit-breaker interposed in the artificial line of the transmitting devices between its artificial line wires and the earth, with the sectional contacts respectively connected to the artificial line wires leading from the said transmitting devices and its other contact connected to that part of the said line leading to earth, and a similar circuit breaker at the other station, the sections of which are connected, respectively, to the instruments at that station and the single contact of which is connected to the main conductor.

442,287. Incandescent Lamp Socket; George W. Hunt and Albert E. Rich, of Brooklyn, N. Y. Application filed Oct. 29, 1890. The combination, with an incandescent lamp having a screw-threaded socket in its base, and a flat concentric contact-ring, of a socket having a threaded pin adapted to engage said thread d socket, and a sinuous concentric contact-ring.

442,336. Carbon Electrode and Method of Making the Same; Isaiah L. Roberts, of Brooklyn, Assignor of one-half to Thomas H. McGraw, of Poughkeepsie, N. Y. Application filed Feb. 14, 1890. The method or process of manufacturing carbon electrodes, which consist in mixing together powdered carbon and an insulating binding material, such as paraffine or its equivalent, heating the mixture to fuse the insulating material, then subjecting the mixture to pressure in a mold to express the excess of insulating material, and then cooling it.

442,338. Relay; Jens G. Schreuder, of Edgewood, Pa. Application filed July 16, 1890. In a relay, the combination of electro-magnets and a gravity armature formed of resilient material, the pivotal support and contact point of the armature being arranged in a plane below the poles of the magnets, whereby the armature is placed under tension when attracted by the magnets.

442,339. Charging Apparatus for Switch and Signal Mechanisms; Jens G. Schreuder, of Edgewood, Pa. Application filed July 16, 1890. In an apparatus for operating switches by fluid pressure operating on a liquid column, the combination of two valve mechanisms, two tanks, each provided with two

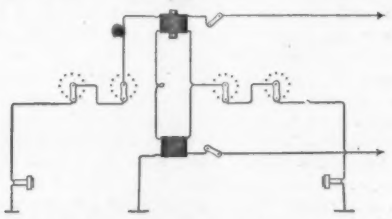
No. 442,139.—MULTIPLE TELEGRAPH OR TELEPHONE.

connections with each of the valve mechanisms, one of the valve mechanisms having an uninterrupted connection with a fluid pressure supply, the other valve mechanisms having a supply and an exhaust connection with the valves of the switch apparatus, and means for shifting the valves of said valve's mechanisms so as to connect the fluid-pressure supply and the supply pipe leading to the switch apparatus simultaneously with either one of the tanks with the exhaust connection of the switch apparatus and with a port exhausting to the air.

442,342. Telephone Toll Station; John W. Vaughn, of Jersey City, N. J., Assignor to Vaughn Automatic Machine Company, of New York. Application filed April 24, 1890. In an apparatus for indicating the deposit and denomination of coins or tokens of various sizes, the combination of an electrical circuit, a circuit, a circuit-changing device located in said circuit, consisting of a series of break-points arranged in the arc of a circle, a contact-point moving over the face of said break-points in contact therewith, a coin way, passage or opening adapted for the reception of said coins, and a movable stop in the path of said coin mechanically connected with the movable part of said circuit changer.

442,347. Railway Car Telegraph; Craig R. Arnold, of Sharon Hill, Pa. Application filed July 13, 1889. The combination of an air or steam train-pipe, an electric circuit containing signaling devices, and a stop-cock with a circuit controller operated by such stop cock for operating the signaling devices in the signaling circuit.

442,365. Electric Traction Increasing System; Mark W. Dewey, of Syracuse, N. Y., Assignor to the Dewey Corporation, of same place. Application filed July 28, 1890. This inven-



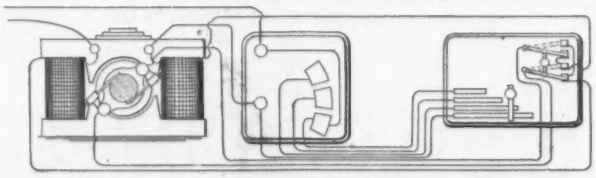
No. 442,139.—MULTIPLE TELEGRAPH OR TELEPHONE.

tion consists in the combination, with a wheeled vehicle and a metallic track for the vehicle to move upon, of a stationary source of heavy current or currents connected to the rails of the track and two or more wheels of the vehicle, and one or more axles, or other low-resistance conductor, extending between the wheels to electrically connect said rails together or complete the circuit between the rails.

442,370. Electric Connector; William H. Garland, of Weymouth, Mass. Application filed Sept. 19, 1890. An electric connector for connecting a small electric conductor to a larger conductor, the same consisting of a cylindrical pin or plug having a straight longitudinal groove on its side of sufficient width to allow the connector to be placed upon the small conductor from the side of said conductor, and said conductor to enter said groove, the bottom of said groove being parallel with the outside surface of the cylindrical plug.

442,383. Non-Interference Fire Alarm Signal Box; Preston V. Merrifield, of Grand Rapids, Mich., Assignor to John Perry, Harry W. Long and Jacob Kleinhaus, all of same place. Application filed March 7, 1890. The invention consists of a box, suitable material, size and shape, divided by a shelf of insulating material into an upper and lower chamber. The lower chamber contains the motor striking mechanism, journaled and supported in a suitable frame resting upon the bottom of the box. The upper chamber contains the non-interference mechanism and the devices for operating the same.

442,385. Electric Leak or Flow Detector; Gustave S. Neu, of New York, Assignor of one-half to Charles H. Simmons, of Brooklyn, N. Y. Application filed March 20, 1890. The combination, with a fluid-conduit having a valve-port, of a flow-detect-



442,208.—SPEED REGULATOR FOR ELECTRIC MOTORS.

ing valve working perpendicularly to said port, and provided with a stem also guided perpendicularly to said port, a circuit closer, and a circuit closer operating rod coupled to the valve stem, and working in alignment therewith.

442,390. Secondary Battery; James Kent Pumpelly, of Chicago. Application filed Feb. 10, 1890. In an electrical secondary battery, the set of plates of one electrode arranged with their broad sides parallel to each other and having corresponding openings in them in register with each other, in combination with the plates of the other electrode arranged with their broad sides parallel with each other and on the same plane as or parallel with the plates of the other electrode and placed within the opening of the first mentioned set of plates.

442,391. Secondary Battery; James Kent Pumpelly, of Chicago. Application filed March 24, 1890. The combination with an electrical battery of cellulose and wood-pulp fiber.

442,407. Electric Railway; Merle J. Wightman, of Hartford, Conn. Application filed April 1, 1885. In an electric railway system, the combination, with a divided source of electricity, of sections of supply conductor located at different distances from the source, and an electric connection for a supply-conductor of a more remote section formed with said source through the supply-conductor of a nearer section.

442,423. Method of and Apparatus for Measuring Electric Currents; Stanley Charles Cuthbert Currie, of Philadelphia, Assignor, by mesne assignments, to the United Gas Improvement Company, of same place. Application filed Dec. 26, 1889. The method of measuring electrical currents by the resultant of two forces created thereby, which method consists in acting upon a movable armature repulsively by one of said forces and attractively by the other, and so proportioning the ratios of repulsion and attraction that as the armature moves from the point of repulsion toward the point of attraction the diminishing repulsive effect thereupon is compensated by an increasing attractive effect, whereby direct readings may be obtained.

442,428. Process of Making Metal Tubes, etc., by Electro-Deposition; Francis Edward Elmore, of Cockermouth, Cumberland County, England. Application filed Jan. 17, 1889. In the manufacture of articles by electro deposition, the method of producing a compact deposit, which consists in simultaneously revolving the cathode in an electrolytic bath, passing a current from the anode through the bath to the cathode, and subjecting the deposited metal to the action of a burnisher gradually moved from one portion to another of the cathode.

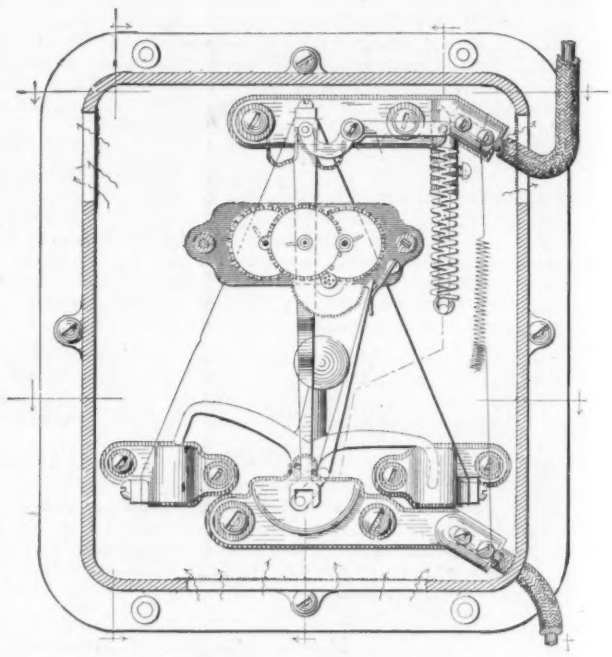
442,446. Trolley Wire Hanger; Henry Herbert Luscomb, of Boston, Assignor to Charles Tennant Lee and the Gould & Watson Company, both of same place. Application filed Sept. 19, 1890. An insulator for overhead conductors, consisting of an insulated clamping device, said clamping device having two jaws curved and tapered at the ends to partially encircle the conductor and having beveled portions and a correspondingly beveled collar co-operating with said beveled portions to close said clamping device.

442,451. Ceiling Block; Harry T. Paiste, West Chester, Pa. Application filed Oct. 14, 1889. The combination in an electric cut-out of the base terminals thereon, a disc of non-conducting material carrying the cut-out mechanism and secured to the base by a confining screw, contact plates on said disc and a cap secured to the disc and adapted to cover the same and its mechanism.

442,452. Ceiling Block; Harry T. Paiste, of Philadelphia. Application filed Feb. 26, 1890. The combination, in a pendant cut-out of the base and terminals thereon, with a cut-out carrying disc, having terminals thereon in line with the terminals on the base, with a cap resting upon the terminals on the disc, whereby on securing of the cap to the base the terminals of the disc and plate are united.

442,459. Electric Motor and Frame; Albert Schmid, of Allegheny, Pa., Assignor to the Westinghouse Electric Company, of Pittsburgh, Pa. Application filed Aug. 1, 1890. In a frame for electric motors, the combination of a single rectangular casting receiving the upper portions of the bearings for the shafts, and separable lower bearings for the shafts bolted to the casting.

442,473. Electric Bell; Charles B. Beers and William B. Tuttle, of Bridgeport, Conn. Application filed Nov. 16, 1889. The combination, in a combined electric bell and buzzer, of two straight electro-magnets mounted side by side, and in separate circuits, each provided with a circuit-breaker, and an armature extending in front of its core and mounted on the core of the other end on opposite sides for the purpose of diminishing the magnetic resistance, whereby, upon passing a current through



No. 442,501.—ELECTRIC METER.

one coil, both cores are made effective for operating the corresponding armature.

442,497. Printing Telegraph; William W. Taylor, of Mansfield, Mass., Assignor of one-half to Ellen Maria Leavens, of Providence. Application filed May 26, 1890. A printing telegraph consisting, essentially, of type-writers electrically connected and having means for operating the type levers thereof, a paper-supply roll mounted in the type-writer carriages and having means for feeding the paper through the type-writers, a box mounted on the type-writer carriages and having a suitable opening therein, a vertically movable two-edged knife adapted to cut off the paper at a desired time and place, means for moving said knife, and a guide fixed to the back of the knife and adapted to align with the opening in the box.

442,501. Electric Meter; James J. Wood, of Brooklyn, N. Y. Application filed Nov. 3, 1888. In an electric meter, the combination of an elongated solid body arranged to be expanded by the heat generated by an electric current in encountering a resistance, a compensating expansible elongated body exposed to the same variations of surrounding temperature, a lever to which both said bodies are independently connected at different points, whereby the lever is moved by the elongating and shortening of both said bodies, and its angular movement corresponds to their differential elongation or contraction, so that the compensating body corrects the disturbing effect of changes in surrounding temperature, and a switch for directing the currents intermittingly through said resistance, connected to said lever to be operated by the angular movements thereof.

442,516. Galvanic Battery; Clarence E. Dutton, Jr., of Washington, D. C. Application filed Sept. 6, 1890. The combination of a battery-jar, a cover therefor, electrodes disposed in said jar, and a clamping rod provided with a head and nut and extending through said jar and projecting through the bottom and cover thereof.

442,575. Conductor for House Lighting; William H. Eckert, of New York, and William H. Gregory, of Brooklyn, N. Y. Application filed Sept. 15, 1890. A conductor for house-wiring or other similar purposes, made in sections, each section consisting of an insulating tube having end plugs, a centrally-arranged wire whose diameter is much less than the bore of the tube arranged therein, metallic heads placed within said plugs, to which the central wire is connected, one of said heads being provided with a male and the other with a female screw, whereby parts of the conductor may be removed by unscrewing one section from another.

442,580. Electric Arc Lamp; William B. Henderson, of Crafton, Assignor of one-half to John T. Birch, of Pittsburg, Pa. Application filed Aug. 4, 1890. In an arc lamp, the combination of two hubs, each provided with radially-arranged holders for carbon pencils, and mechanism for rotating said hubs so as to bring said carbon pencils into operative relation to each other successively.

442,588. Electric Switch; Norman Marshall, of Boston. Application filed June 11, 1890. In a circuit controller for incandescent electric lights, a base plate and flattened rotary spindle, in combination with a four-track cam, alternate tracks being in electrical contact with the wire connectors, and a spring-pressed contact-plate fitted to slide vertically on side spindle.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1836—can be had for 25 cents. Give date and number of patent desired, and address The W. J. Johnston Co., Ltd., Times Building, N. Y.

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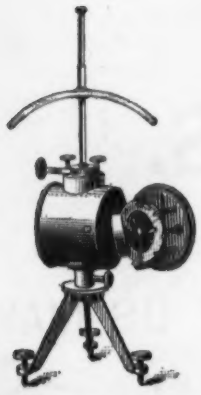

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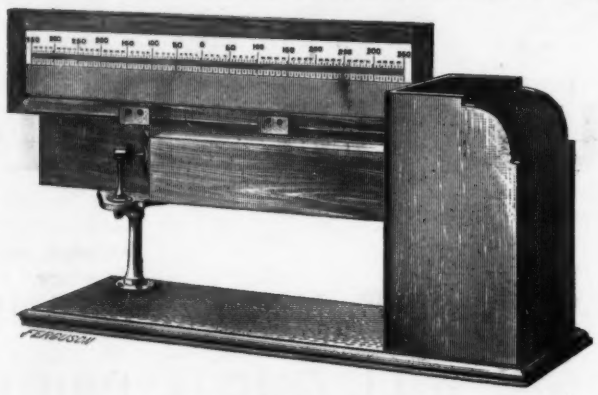

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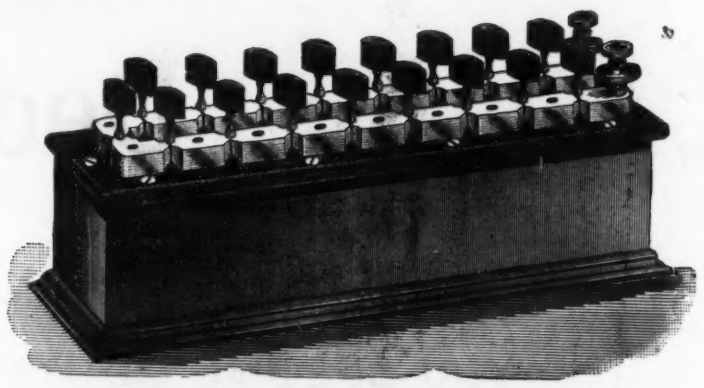

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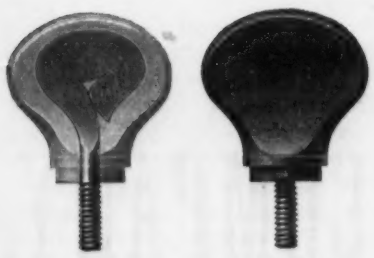

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